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## *FACTS LIMITING THE THEORY OF HEREDITY*[1]

MY first duty is to acknowledge the honor done me by the suggestion that I should deliver the address in this section. I need not say that I very highly appreciate the distinction thus conferred.

The fact that a heredity section has been constituted is surely a matter for congratulation. It is a sign that the study of zoology is passing into a maturer stage. For the past half century zoologists have been chiefly occupied with the accumulation of morphological facts of structure and development. The perfection of microscopical methods had revealed regions in which knowledge could be readily advanced by simple means. We became, therefore, students of Cœlenterata, insects, Vertebrata, or whatever it might be, according as fancy or opportunity had specially attracted us to one or other of these groups.

Such work was interim work. It was making up arrears. This task is now practically accomplished. Almost all that can be seen by these simple means has been seen. One more phase is over. The division of our subject matter according to the groups of the animal kingdom is no longer adequate.

We are trying for fresh points of attack. Our forces are disposing themselves in new formations, with fresh centers and a new front. In the organization of the present congress the change has been recognized,

[1] Address delivered at the International Zoological Congress, before the Section of Cytology and Heredity, August 23, 1907.

and the creation of this section and of sections for experimental zoology and cytology testifies to the existence of new methods and new hopes.

Limitations of the animal classes do not trouble us. We take facts wherever we can find them. We are botanists to-day, zoologists to-morrow. The widening of interest which the study of heredity is bringing into modern zoology must prove a great benefit to the science.

When morphology was a new idea, everything was sacrificed to its pursuit. Physiology, systematics, all were discarded as useless lumber. Let us not repeat that short-sighted mistake. In the wider survey which we are attempting we shall need all these things. If we are to understand rightly the phenomena of specific difference—to take that problem only—we shall be glad of anything that the systematist can tell us, and of many deductions of pure physiology.

The study of heredity and variation—of genetics, to use our modern term—is itself a purely physiological inquiry, and as such it must range itself among other physiological inquiries; standing next beside, and looking constantly for support to, physiological chemistry.

The accidents of development which dissociated zoology from physiology were, as we are beginning to perceive, a misfortune, though perhaps an inevitable one. The botanists are happy in that their smaller dimensions have prevented such disruption. But let us hope that the dynamics of the zoological system may admit of the retention of that part of physiology which still adheres. Genetics will grow to be a big sphere one day; but may it never break off from the parent body whether as satellite or as sun.

Let us now examine the task which lies before us as students of genetics. Various descriptions of our objects may be made, referring to the phenomena of heredity and variation; their bearing on the theory of evolution, or on the origin and destinies of races. Stripped of all that is superfluous and of all that is special to particular cases, genetics stand out as the study of the process of cell-division. For if we had any real knowledge of the actual nature of the processes by which a cell divides, the rest would be largely application and extension. It is in cell-division that almost all the phenomena of heredity and variation are accomplished. Nothing is more easy than to witness this process. We may behold its minutest visible details when we please and as often as we please, and still no one has even a plausible guess as to the essential nature of the process. Two centers form: the parts collect round each. The two halves withdraw; or, if we may commit ourselves so far, repel each other, and there are then two cells instead of one. The likeness of those two cells we call heredity; their difference we call variation. If the two cells remain constituent parts of one body, we may speak of their likeness as symmetry or repetition; and their points of unlikeness we then call differentiation. But *how* the two centers were formed, not to speak of *why,* and how they came to separate, we have no surmise. Still less can we conjecture what it was that decided the distribution of differences between the two halves. No phenomenon of common life is so obscure.

By suitable means many of the finer details can be watched, but the most meticulous observation has failed to disclose the essential truth which must yet be so near. I am speaking in a country where by the determination of vigorous observers a great school of cytologists has arisen who have greatly added to knowledge of the percep-

tible features. They will, I think, agree with me that were the powers of the microscope increased many times, it is unlikely that we should be very much wiser than we now are. Evidence of a different sort is needed.

Others by great ingenuity have tried to penetrate a little deeper by making models which in various ways can reproduce something of what is seen to occur, but the features thus represented are those which occur *after* the two centers are formed—the consequences, that is to say, of the division, not the division itself.

That remains a phenomenon unparalleled in the physical world, like consciousness, a distinctive property of living matter. By no confection of chemistry or mechanical contrivance can we yet fit together a system which will dichotomize and grow, dichotomize and grow, repeating the process again and again as long as certain materials are supplied to it.

The point on which I wish here to lay the emphasis is the failure to conceive or to represent the dichotomy. Heredity, as we commonly see it, is much more than that, but the dichotomy is the one feature common to all its manifestations. I have sometimes thought that in our investigations of the later and more special phenomena of inheritance there is a danger of forgetting that this is the essential fact. In the visible rearrangement of the chromosomes, for example, in mitoses, occurrences so tangible and striking are witnessed that the observer can hardly avoid exclaiming, "This is the essential process of heredity," or "Those chromosomes which I can watch and count must be the physical basis of hereditary likeness." Attractive and stimulating as those wonders are to behold, the essential is still beyond. Heredity began in the explosion which impelled the chromosomes on their courses. If it were possible to identify the chromosomes ever so clearly as the physical bearers of hereditary characters, the problem of the division would remain, and I am strongly led to expect that it must be in some new light on the causation of the division that the way to attack the essential problem will be found. In this expectation I am glad to find myself in agreement with Dr. Loeb, whose stimulating address we heard yesterday. The researches which he has so successfully inaugurated have brought the problem of cell division at last within the range of experiment; and if the nature of the explosion remains still inscrutable, Loeb's work has shown how the charge may be fired.

In our deliberations I anticipate that the more immediate question, whether the chromosomes are or are not the bearers of hereditary characters, will be fully debated. Without presuming to a definite opinion on this question, I venture to state what seem to me formidable difficulties in the way of this expectation. If the chromosomes were directly responsible as chief agents in the production of the physical characteristics, surely we should expect to find some degree of correspondence between the differences distinguishing the types, and the visible differences of number or shape distinguishing the chromosomes. So far as I can learn, no indication whatever of such a correspondence has ever been found. Besides this, although no very thorough investigation of the chromosomes of somatic structures has yet been made on an extensive scale, I believe that definite cytological distinctions between the nuclei of the various tissues *of the same body* have not been detected. If chromosomes were the chief governors of structure, surely we should find great differences between the chromosomes of the various epithelia, which differ greatly in their structure and properties. As these cytological differences have not been found consistently

there, the prospect of successfully tracing them among the specific types does not look very hopeful.

Again, no correspondence between the chromosome numbers and complexity of structure has ever been asserted to exist. Low forms may have many; highly complex types may have few.

Then, on the contrary, very closely allied types may show great differences in these respects. As you are aware, Rosenberg has shown that one species of *Drosera* has 20, while another has 10.[2] Again, Miss Lutz has found a similar state of things in *Œnothera gigas,* which has 28, while *Œnothera lata* has 14. Obviously this doubling means something definite, but it is not suggestive of the determination of specific difference. In *Aphis* Miss Stevens, on the other hand, has shown how wide a diversity may be presented by the chromosomes of forms so alike as to have passed for one species. These differences prove both too little and too much. I can not but believe that all this evidence points to the conclusion that we are about to find among the chromosomes one more illustration of the paradoxical incidence of specific difference, not the fundamental phenomena on which that difference depends. Among coleopterists punctulation is sometimes a feature of great systematic importance. To dipterists neuration and chætotaxy sometimes give useful critical data. In certain orders of Lepidoptera, the Hesperidæ, for example, the structure of the gonapophyses sharply distinguishes the species where all outward tests fail. But proceeding farther with each of these criteria, we are sure to come upon other groups where for a long series of diverse types the critical feature, so important elsewhere, may show no differences, or, on the contrary, may show hardly any stability. I have digressed outside my province in these remarks. My excuse must be that I have a rare opportunity of speaking to a great school of cytologists, who must, sooner or later, become the colleagues of us breeders in the attack on genetic problems, and I can not resist saying how the facts strike an observer who is highly interested, and I may truly say unprejudiced. I suspect, then, that the specificity of the chromosomes may conform in general to these other phenomena of specificity.

[2] Important evidence as to these chromosome numbers has been published by R. R. Gates, *Botanical Gazette*, February and July, 1907.

There remains the suggestive fact that all that has been witnessed regarding the behavior of the chromosomes is in fair harmony with the expectations which our Mendelian experience would lead us to form respecting the hypothetical "bearers" of varietal differences. On the other hand, with one striking exception, nobody has been able to connect a cytological difference with a character-difference in any instance. The exception, of course, is the case of the accessory chromosome which Professor Wilson so admirably demonstrated to us yesterday. Of that I shall speak again hereafter.

But though, in regard to these profounder questions, our knowledge is so defective, the results of experimental breeding are beginning to limit the problem in very definite ways. We know first the fact deduced from Mendel's original experiments with peas, that the bodily characters may result from the transmission of distinct unit-factors. According to Mendel's own conception these factors existed in alternative or allelomorphic pairs, of such a nature that only one member of any one pair can be carried by a gamete. Now though we can not quite prove this first account to be wrong, it is nevertheless possible to express all Mendelian phenomena in terms of a simpler system, according to which the allelomorphism may be represented as con-

sisting essentially not in the presence of separate factors for the dominant and for the recessive characters, but in the *presence* of something constituting the dominant character which is *absent* from the recessive gametes. So satisfactory, indeed, are the results of this mode of representation that the probabilities are greatly in favor of its truth. Indeed, when the interrelations of a complicated series of varietal types have to be dealt with, the presence-and-absence system, as we may call it, applies so readily that its correctness is scarcely doubtful.

In simple cases, for instance, in that of the rat, we may regard the color gray and black as due to the operations of gray and black determiners acting upon a distinct factor for color. According to the scheme promulgated by Cuénot, the two determiners, gray and black, are regarded as allelomorphic to each other.

Such a system, however, fails when, as in the case of mice, a third color-type (in addition to the albino) viz., chocolate, has to be expressed. If, on the contrary, each determiner is regarded as allelomorphic to its own absence, a workable system is provided, which can deal with almost all the observed facts. The gray—or technically, agouti—mouse, then, contains all the factors. The black is black because it is minus the determiner for agouti, and the chocolate is wanting in the determiners both for agouti and for black. The relations of all the color types to each other are thus clear except in so far as the relation of yellow to the other colors is not quite satisfactorily accounted for on either system.

It is at present beyond my purpose to examine the suggestions made to deal with that particular difficulty, but leaving this special question on one side, we can draw the clear deduction that each of these varieties owes its existence to the absence or removal of some factor, from the gamete of the type.

Conversely in other cases we perceive with equal certainty that the variety is due to the addition of such a factor.

To deal with this series of interactions, the simple conception of dominant and recessive is inadequate. We now need a term to denote the relation between dominant factors belonging to distinct pairs of allelomorphs.

Till lately we spoke of the relations between the gray color of the mouse to the black color in terms of dominance. Those terms, strictly speaking, should only be applied to members of the same allelomorphic pair. We can perhaps best express the relation between the gray and the black by the use of the metaphor "higher and lower," and I therefore suggest the term *epistatic* as applicable to characters which have to be, as it were, lifted off in order to permit the lower or *hypostatic* character to appear. The same method of representation is, of course, applicable to the series of factors for pattern and for intensity of color.

The case of patterns is in a special way instructive. Symbolically we can represent pattern as due to determining factors, like those which cause the tint or the intensity of color.

Though justifiable as a symbolic representation, it is evident that the "factor" for pattern may really be a quantitative difference in the amount of one of the elements, presumably the chromogen. We may imagine that the color appears on special parts, just as color takes on the prepared surface of a lithographer's stone, always remembering that though the distinction between, for example, self-pattern, the Dutch-pattern and the English-pattern rabbit may thus be quantitative, the quantitative stages are fairly well defined.

The point is of interest inasmuch as

when we come to estimate the minimum number of transmitting elements, it is superfluous to postulate additional elements as instruments in effecting these alterations in pattern, seeing that the change may very readily be imagined as due to a series of quantitative subtractions from the qualitative elements. If then we can thus regard the distribution of color as dependent on subtraction-stages of some one element, say the chromogen, we are naturally led to refer the various intensities to another similar but also definite series of subtraction-stages in which the subtraction is spread over the whole field, and so on for the other qualities.

Two fairly distinct classes of difference may thus be presumed to exist, those depending on the qualitative elements and those due to quantitative subtractions from them. The latter may be again subdivided.

It is scarcely necessary at this time to repeat that almost all the subtraction-stages fully studied are fairly definite, and their existence implies no suggestion of general failure of segregation. Interesting experiments have recently been made by Castle and McCurdy, exhibiting positive results of selection inside the limits of one of these stages, viz., the so-called hooded type in the rat. Nevertheless, the maximum result attributable to selection in such cases is a modification within the limits of one particular varietal type.

Such evidence provides no escape from the conclusion that each genetic variety comes into existence by a special addition to or subtraction from the genetic equipment.

Of all the results to which experimental work has led us, that which to me is the most astonishing is the fact that the same systems of transmission should be followed by characters which, by whatever test they are judged, must be supposed to be most diverse in physiological causation. Naturally when we are dealing with changes in color, for instance, or in the reserve materials of a seed, we surmise that the critical factor is a certain ferment, or rather, the power to produce that certain ferment. It is perhaps not too wide a stretch of imagination to regard susceptibility to fungoid disease as caused by some similar body. The diversity of these ferments must anyhow be very great, and it seems very strange that all these multifarious potentialities should exhibit gametic allelomorphism. Let us take an illustration. Color, as we can prove in regard to several plants, and in regard to the plumage of fowls, is due to the meeting of two complementary factors. One is presumably a ferment. Recent research strongly suggests that it is a tyrosinase. The other is referred to as a chromogen. But whatever they are, the two bodies, or rather the factors which produce them, must be of utterly different nature, and yet, genetically, the two potentialities are treated similarly. Each is allelomorphic to the absence of such a power.

How much more astounding is it, that when we pass to qualities such as length of stalk and shape of flower, or of a cock's comb, the quality of the hair in rabbit, we still find the same rules in strict and undeviating operation. Any scheme of heredity on a scale comprehensive enough to deserve the title of theory must deal with this surprising fact.

There is another extraordinary feature in the behavior of allelomorphs which, though known clearly in a few cases only, must certainly play a great part in the fuller elucidation of heredity. This is *partial gametic coupling.*

Mr. Punnett and I have for some time been engaged in studying this phenomenon in the sweet pea (*Lathyrus odoratus*) and we have recognized indications of the same thing elsewhere. The section will perhaps

forgive me for taking a botanical illustration. I have no doubt it will not be long before cases in animals are found.

In the sweet pea, then, we know experimentally about eleven distinct allelomorphic pairs. The actual number is, of course, much greater, but eleven have been critically demonstrated.

Of these characters some are concerned with the production of color, others with the determination of form. The composition of the $F_2$ families shows that several of these allelomorphs are not distributed independently among the gametes, but that certain combinations of characters occur with greater frequency than others. The first of these couplings to be made out was that between the normal or *long* pollen shape and the factor which determines *blue* color. In the absence of the long pollen factor, the pollen is round. In the absence of the factor for blue, the flower color is red. The coupling here is such that the $F_2$ numbers instead of being 9 blue-long + 3 blue-round + 3 red-long + 1 red-round, are 41 : 7 : 7 : 9, or very nearly so.

This system would be produced by the following gametic series: 7 blue-long + 1 blue-round + 1 red-long + 7 red-round.

It is not possible to decide strictly whether the series is 7, 1, 1, 7, or 8, 1, 1, 8, and, of course, the dichotomies which produce the one or the other of these systems must be entirely different, but the total of the series is either 16 or 16 + 2.

Now the other two instances of partial coupling show that the association is there in groups of either 32 or 32 + 2. In the first case the blue factor and the pollen shape are again concerned, but their proper system of coupling is disturbed by the presence of another element, that which governs the shape of the flower.

The three pairs of characters are then:

| *Dominant* | *Recessive* |
|---|---|
| 1. Blue. | No blue, viz., red. |
| 2. Pollen long. | Pollen round. |
| 3. Standard upright, having central notch. | Standard hooded, without a central notch. |

Now, experiment has shown two things. First, that in these families there is a total and complete coupling of *blue* and *hood*. In other words, all gametes destitute of the upright standard factor have the blue factor, while all gametes bearing the upright standard are destitute of the blue factor. Consequently, there are in such families three types of plants, distinguishable by the shape and color of their flowers:

1. Blue—hooded standard.
2. Blue—erect standard.
3. Red—erect standard.

Classes 1 and 3 are homozygous, but 2, which in this curious instance happens to be the wild type of sweet pea, is here always heterozygous, like the blue Andalusian fowl. Consequently we meet the paradoxical result that of the three types produced in such a family the original wild form is the one which does not breed true, but continues to throw off the other two types.

It is only by a stretch of language that we can speak of the blue factor as coupled with the hooded shape; for the hooded shape is recessive, and thus may be regarded as the shape due to the removal of the factor for upright standard. A more strict way of describing the facts would be to speak of erect standard and blue factor as gametically alternative to each other. It is thus possible that we may have eventually to extend the conception of allelomorphism to cases like this where two characters, both dominant, due, that is to say, to the presence of some factor, are alternative to each other in the constitution of the gametes.

To return now to the distribution of the pollen characters in these families: the $F_2$

numbers prove that the coupling between the blue factor and the long pollen character is altered and becomes far more complete. When the hood standard is segregating from the upright standard at the same time as the blue is segregating from the red (viz., non-blue), and the long pollen from the round pollen, the gametic series is no longer 7 blue; long + 1 blue; round + 1 red; long + 7 red; round, but is evidently 15 + 1 + 1 + 15, unless, as is still possible, the actual numbers are 16 + 1 + 1 + 16.

A second case of this peculiar distribution exists in regard to the two characters, sterility of anthers and absence of colors in the axil; there the association is 15 (or 16) fertile ♂; colored axil + 1 fertile ♂; green axil + 1 sterile ♂; colored axil + 15 (or 16) sterile ♂; green axil.

The $F_2$ numbers resulting from the recombinations of two pairs of allelomorphs distributed independently, and according to various simple systems of partial gametic coupling may be tabulated as follows. In each pair one of the factors is taken to be dominant over the other.

| | $AB$ | $aB$ | $Ab$ | $ab$ | Total |
|---|---|---|---|---|---|
| No coupling. | 9 | 3 | 3 | 1 | 16 |
| 3 . 1 . 1 . 3 | 41 | 7 | 7 | 9 | 64 |
| 7 . 1 . 1 . 7 | 177 | 15 | 15 | 49 | 256 |
| 15 . 1 . 1 . 15 | 737 | 31 | 31 | 225 | 1024 |

and so forth.

Curiously enough, we have as yet no certain case of the coupling in a series of 8, viz., 3 + 1 + 1 + 3, though we can scarcely doubt that the system exists. There are, however, clear indications that couplings of a still closer order exist and we may reasonably expect them to fall into systems corresponding with the series of powers of 2. This evidence will, in all probability, be of great assistance in the attempt to close in on the question of the moment at which the segregation of characters is effected and must be taken into account in any discussion of the nature of the dichotomies themselves. It becomes very difficult to suppose in these cases of close though still incomplete coupling that all the segregations occur at the reduction division—or indeed at any single division—and we await with some interest the result of cytological studies of the antecedent stages in maturation. The difficulty reaches its maximum when we attempt to conceive the process of character distribution among the egg cells of plants. The male cells in plants and animals are so numerous that their numbers supply sufficient scope for the formation even of very long series of couplings. The egg cells, on the contrary, are few, and very often definitely grouped in special organs which again are arranged on a definite geometrical plan relatively to the gross anatomy of the plant. Even if the various accessory cells of the plant ovary are reckoned as belonging to the gametic series, the number seems still insufficient to allow for the development of a coupling which demands a long series for its expression. Is there, then, any organized system of differentiation connecting the several ovaries into a common plan? In maize and peas, where indications of this system might be expected to be found if they existed, the evidence is entirely negative, and that is all which can be positively asserted.

Turning now to another aspect of the problem, we have to look for facts which may help us to limit our search for causes of variation. We may, as I have said, assume that a vast number of variations are due to the addition or removal of definite factors. We begin, therefore, to have some dim conception of the nature of this class of variations, and at all events to appreciate that they must occur as definite and specific events. As to the causation of these events, there is almost no

light. A few months ago, I think it would have been scarcely an exaggeration to have said there was none. It is, however, impossible not to recognize that the striking experiments lately published by Tower may be a positive contribution to this part of the inquiry. We can scarcely imagine that changes in temperature or in moisture are the great or chief efficient causes of natural variation; still the fact that in Tower's experiments such artificial changes in conditions appear to have effected a modification in the germ cells of the potato beetle (*Leptinotarsa decem-lineata*) and to have permanently deflected the offspring into a recessive line, must be allowed weight in future discussions of these phenomena. Many points in that fine piece of work still remain to be cleared up, but a very remarkable beginning has been thus made. It is, perhaps, scarcely necessary to add a warning that though the response to change of conditions may have been direct, it must not be hastily concluded that the response is adaptive. The appeal to direct responses so common in evolutionary discussions of thirty years ago, was made to account for the complex adaptations of organism to environment. It is the total want of any evidence supporting that appeal which has driven most of us to disbelieve in the reality of any such claims, and there is nothing in the new evidence, I think, which should shake the attitude of resolute agnosticism which we have thus been led to adopt.

Similar reflections apply to another very curious instance of genetic change induced by more violent means. MacDougal states that by injecting zinc sulphate into the ovary of *Raimannia* he caused the plant to produce seeds which became small and depauperated plants, destitute of the ciliation characteristic of the parent species. These, in their turn, transmitted the new character to their descendants.

The facts which I have referred to as helping to limit our view have been drawn from the behavior of a considerable range of characters and, as I have said, there are strange elements of similarity common to all. Respecting two very important classes of characters we still remain in almost total ignorance. Some years ago in attempting a provisional survey of variations I distinguished a special group of phenomena as *meristic*, that is to say, belonging to those occurrences by which division and repetition are effected in animals and plants. Obvious as the meristic differences are, we know very little as to the system followed in their inheritance. Only one case is clear, I believe. Farabee has shown that the peculiar condition of the human digits in which the fingers and toes have only two phalanges each, behaves as a simple dominant. Dr. Drinkwater has very kindly sent me lately a table which he will shortly publish, showing exactly the same thing in an English family. In his family, as in Farabee's, the affected members were of very short stature. I can not at all readily conceive how any ferment or other transmissible substance can be supposed to be responsible for such a variation as this. It is true that the attacks of gall-flies or of fungi may excite branching, or proliferating cell division in plants, and we may have to suppose that a poison can have this effect. Perhaps we may also imagine that the fine division of the hair follicles in Angora rabbits or Merino sheep may be due to the want of some substance which in the normal type inhibits or checks this excessive subdivision, but if we are to bring the two-phalanged digits into line with the rest of these observations we shall have to make

an extreme demand upon the specific powers of chemical substances.

Polydactylism has thus far failed to give clear indications. Sometimes the inheritance is Mendelian, while in other strains or individuals dominance is so irregular that the descent becomes untraceable. Such irregularities of dominance here, as elsewhere, may be referred with some probability to the disturbing influences of other undetected factors. It is much to be hoped that cases of difference in the ground-plan numbers of some radial type will be found amenable to experimental tests. Here the problem may be found in a somewhat simplified form on account of the elimination of serial differentiation.

One most interesting class of characters remains untouched. I refer to right- and left-handedness. I can form no surmise as to the laws which will govern the descent of these characters. From Mayer's observations on *Partula* we learn that parents of either twist may bear young of either twist. The numbers in the uteri were so small that the absolute numbers were insignificant, and it may be an accident that no mixture of types was found in any one uterus. Direction of twist is a fundamental meristic phenomenon, being, as Crampton and Conklin have proved, determined as early as the first cleavage plane; and great light on the problem of cell division might perhaps be obtained if the inheritances of these differences could be determined. The only case we have studied, that of *Medicago,* in which the fruits are right- or left-spirals according to species, proved unworkable, perhaps on account of the minute size of the flower and the roughness of the manipulations.

I must now refer to the one positive case alluded to above, in which a chromosome difference has been proved to be associated with a somatic difference. McClung, studying the accessory chromosome first observed by Henking was the first to insist on its importance. He showed that in certain insects half the sperms have it and half are without it. This fact led him to make the natural suggestion that the structure might be concerned in the differentiation of sex. This suggestion has been shown by Wilson to be correct, but the accessory body proves to be the peculiarity of the sperms which are destined to form *females,* not of those which will form males, as had been previously supposed. It was with no ordinary feelings of pleasure that in the past week many of us in Woods Holl, and again the large audience assembled in this room, beheld the fine series of photographs which so amply demonstrate Wilson's far-reaching discovery.

The definiteness of the facts is evident beyond all question, and whether the accessory body is in these types the "cause" of femaleness or only associated with that cause, we have at last the long-expected proof that sex is determined in the germ cells, so far as these specific cases are concerned. In those cases we may even go farther and declare that the female is homozygous in femaleness, while the male is heterozygous in sex. Such a result accords well, I think, with the general conclusions to which breeding experiments, on the whole, point. For though great disparities between the proportion of the sexes occur in certain matings, these disparities seem to be obliterated in succeeding generations. If the one sex were homozygous and the other heterozygous, such impermanence of the divergences is what we might naturally expect.[3]

[3] In these remarks I have of course in view the case where the actual number of the two sexes show strange departures from equality. The phenomena recorded by Doncaster in *Abraxas grossulariata* and by Standfuss in *Aglia tau,* where the proportions of the sexes belonging to two varietal

Of course, the association of sex-distinction with an accessory chromosome is admittedly a peculiarity of certain types, but science proceeds by the discovery of prerogative instances, of which surely this notable illustration will long be remembered.

While knowledge has of late progressed so rapidly in regard to many genetic phenomena, we still know next to nothing of the facts relating to the incidence of partial sterility among heterozygous forms. Guyer found that the abnormality of which the sterility of hybrid pigeons is the expression, begins in the reduction-division and is apparent as an entanglement of the chromosomes which fail to divide. In many cases sterility is partial; and for example, a proportion of good pollen-grains occurs mixed with the aborted grains. Fuller examination of these cases would probably lead to interesting results.

In selecting facts which tend to limit our outlook on the phenomena of heredity I have naturally chosen to speak rather of features which are positive and mutually consistent than of the many negative and thus far conflicting items of evidence which must perhaps one day be allowed their weight. The real value of these negative and frequent doubtful observations is as yet so uncertain that they must be regarded rather as hints to be followed in the pursuit of facts than as facts already ascertained.

Allelomorphism, as we are becoming more and more disposed to believe, consists in the separation of a positive something from the absence of that something: More correctly, perhaps, we should say that the thing which conveys a certain power segregates, leaving in that cell division no representative of that power behind. This allelomorphism is the one fact of which we have the clearest proof. It may govern, as we have seen, features of the utmost diversity. What then is that allelomorphism? An essential phenomenon of cell division, it is not: for in homozygous organisms the products of division are alike. Any theory of heredity must include and recognize both these two kinds of division in its purview. We seek vainly as yet for a scheme by which these two sorts of division may be represented.

I do not know that analogy is helpful in these cases, but in my own mind I sometimes remember in this connection that the somatic divisions themselves are also of two types. There are segmentations which, as in radial animals or bilateral animals, divide similar parts from each other, and there are also the serial divisions by which series of differentiated segments are produced. It seems to me just possible that the heterogeneity among the differentiated segments may have some point of real resemblance to the heterogeneity of allelomorphs. I suggest this comparison with only a faint hope that it may prove sound.

Lastly, any scheme of heredity must be able to recognize the possibility of gametic coupling between allelomorphs belonging to distinct pairs, and though few such couplings have yet been proved, we have good reason to believe that yet other systems of couplings of much higher complexity exist.

Dr. Loeb encourages us to look to chemistry for the fulfilment of our hopes, and often, as in the case of the sweet peas, of which I have spoken, we come very near indeed to something like simple chemical phenomena. Of chemistry I know little, but I would ask those who are experts in chemistry whether it is in harmony with

types followed peculiar but consistent systems, are evidently to be referred to the effects of coupling, as Doncaster has shown.

chemical conceptions that, in all the range of characters with which we, breeders, have dealt, no phenomenon suggestive of valency between characters has been observed. Everywhere we meet the fact that on an average the number of germ cells in which our allelomorphs are present is the same as the number in which these allelomorphs are absent. Whatever the kind of characters concerned, equality of number is the rule. While, therefore, we see very readily that the operations of the allelomorphs are due to chemical action, allelomorphism itself can not be expected to prove a chemical phenomenon in any simple sense. Allelomorphism is rather to be compared to the separation of substances which will not mix, and it is not impossible then in some of our more complex cases we are concerned with various phenomena of imperfect mixture. The elucidation of this part of the subject must be left to the physicist.

I can not conclude without expressing something of the delight which I feel that biologists are at length devoting themselves in good earnest to genetic problems.

To those whose memories go back even to the International Congress of 1898 in Cambridge the change is indeed amazing. Then we spoke little of genetics—little, that is to say aloud, or in official programs, though under our breath some of us were murmuring of these things. In this congress the voices that we dared not raise in 1898 are rather in danger of hoarseness from too much speaking. But, seriously, we students of genetics may look forward to the future with great confidence and hope. Those who next week will see Professor Davenport's magnificent institution at Cold Spring Harbor will appreciate that a wonderful and most hopeful beginning has been made. The work of Professor Davenport and his staff, of Professor Castle, at Harvard, of Professor Tower, at Chicago, and of others I might name, are all evidences that a great and combined advance has begun. We in Europe will bear our part also, and if we have not any very fine equipment we must console ourselves with the thought that light-armed troops may move the faster for a while. With their base on Cold Spring Harbor, or Woods Hole and the Biologische Versuchsanstalt in Vienna, the allied armies of genetics, cytology and experimental zoology they start for the grand attack; and I think when we meet at the end of another period of ten years, there will be victories to record.

William Bateson
Cambridge University

## SCIENTIFIC BOOKS

*Résultats du Voyage du S. Y. Belgica en 1897–9, sous the commandement de A. de Gerlache de Gomery.* Rapports Scientifiques. Zoologie. *Insects* par G. Sévérin (and twenty others), 92 pp., 4°, V. pl., 1906; *Ostracoden* von G. W. Müller, 8 pp., I. pl., 1906; *Holothuries* par E. Hérouard, 17 pp., II. pl., 1906; *Medusen* von Otto Maas, 32 pp., III. pl., 1906.

A fresh batch of the valuable reports of the Belgian Antarctic Expedition have come to hand, the printing and illustrations of the elegance which has characterized the series.

The number of insects which have been brought back from the Antarctic remains pitiably small, and in marked contrast with the richness of the Arctic regions. Besides the Collembola taken in the Gerlache channel, a *Podurella* and pedicularian obtained by the *Southern Cross,* no insect is known except a Chironomid fly of the new genus *Belgica,* and the larva of perhaps another species of the same family. These minute creatures, whose wings are so reduced that they are incapable of flight, are found in the vicinity of small pools of water where the seabirds roost on the rare bits of bare ground or rock which are exposed along Gerlache Channel.

A number of interesting insects were obtained in the Magellanic region and at the Falkland Islands. These are also treated of in the present publication.

A few ostracods, mostly belonging to the genus *Conchœcia* or *Paradoxostoma,* were obtained from the plankton between 69° 48′ and 71° 15′ S. Lat.

The Holothurians comprise nine species, of which five are new, including the new genus *Rhipidothuria;* and which were procured chiefly between S. Lat. 69° and 71° 18′ in deep water, or in the plankton collections.

The Medusæ are also rare, only two of strictly Antarctic habitat having been taken, *Homœonema racovitzæ* and *Isonema amplum.* The second generic name, it may be noted, is preoccupied for a Mollusk since 1866 by Meek and Worthen, and might be replaced by *Arctapodema.* The other forms discussed are mostly from the subantarctic plankton, none of them identical with Arctic species, though one of them is supposed to be Mediterranean in distribution. WM. H. DALL

*National Antarctic Expedition, 1901–1904, S. S. Discovery, commanded by Capt. Scott R. N. Natural History.* Vol. I., Geology. London, the British Museum (Natural History). 1907. 160 pp., 4°, pl. X. Field Geology, by H. T. FERRAR, Geologist to the expedition (100 pp.). Rock Specimens, by G. T. PRIOR, Asst. Brit. Mus. (40 pp.).

We have already reviewed the second and third volumes of this excellent report, and now are able to notice volume I., which has recently appeared.

The part of South Victoria Land studied by the members of the expedition consists of a great range, or series of mountain ranges, stretching in a line almost direct from latitude 71° to latitude 82° south, a distance of some 800 miles. Some of the peaks rise to a height of 13,000 feet, and it is remarkable that there is no extensive area of land lower than 4,000 feet. Off this bold coast line is the shallow Ross Sea, with occasional islands close in and in a series roughly parallel to the coast.

In the vicinity of the winter quarters the Ross Archipelago, including the large Ross Island which bears Mts. Erebus and Terror, is composed of recent volcanic rocks. Mt. Erebus emits steam, but during the stay of the expedition no ejection of dust, lava or other solid matter was observed.

On the opposite side of the gulf, westward from Ross Island the rocks are quite different, having for a basal platform a gneissic series with which a pure white coarsely crystalline limestone in places is associated. Above this lie granites with interstratified sheets of dolerite, occasionally thin seams of micaceous schist, and narrow basaltic dykes. The granites are capped by a yellowish sandstone which reaches a thickness, of 2,000 feet or more, and at certain localities retains carbonized traces of vegetable remains. These rocks were horizontal or inclined only at comparatively small angles. The carbonaceous matter occurs in sufficient quantity to form blackish bands in the strata, which also show at times cross-bedding, pebble bands, and yellowish argillaceous mudstones or concretions up to two inches in length. Some calcareous layers were also noted.

Above the sandstones the uppermost horizon consists of intrusive dolerites, sometimes columnar.

Full notes are given on the inland and sea ice. The former covers and obliterates the inequalities of the interior land surface, leaving coastal land fringes, comparatively free from ice. The floe or sea-ice rarely exceeds eight feet in thickness, and, if depressed by a deposit of snow above, the lower surface of the floe is removed by the action of the sea to an equivalent extent, so that, according to Ferrar, it seems impossible that the thickness of the floe can be increased to any very marked extent by the addition of snow to the upper surface. The rise of the inland ice from the coast inland is very gentle and almost imperceptible, so that it seems as if, should an elevated hinterland occur at all, it must be at a considerable distance inland.

Denudation in this region seems largely due to wind action, the temperature being so low that erosion by water flow is hardly possible. Exposed surfaces of rock rapidly disintegrate into dust, but at a small distance below the

surface, where solidly frozen, practically no erosion of rock surfaces takes place.

The wind carries away the dust of disintegration; loose stones are often smoothed and pitted by the sand blast, as in desert regions; and some of the harder surfaces receive a superficial glaze. Wind carries away the smaller rock fragments, and, on rare occasions, the sudden outbursts of short-lived glacial torrents spreads mud and sand over the surface of floating glacier ice.

Sulphate and chloride of sodium occur on the floating ice, partly as concentrates or exudates from freezing sea water, sometimes in mounds several feet across and as much as two feet thick.

In a general way the ice must be regarded as at present retreating, though the amount of retreat is moderate. The rocks in their petrologic aspect are thoroughly discussed by Dr. Prior.

The text of the volume is replete with excellent half-tone cuts from photographs, and to the plates are added two well-executed charts. WM. H. DALL

*Clean Water and How to Get It.* By ALLEN HAZEN. New York, John Wiley & Sons.

Nothing could be more timely than a book dealing with the subject of water supply, for all over the country there is a remarkable awakening of interest in improvements along this line. High death rates from typhoid fever in American cities have too long been a reproach to our civilization and the inaction which has permitted them is rapidly giving way to a wholesome spirit of reform. No one is better fitted to meet the need for popular treatment of this subject than Mr. Allen Hazen, whose own engineering skill has contributed so largely to develop the newer methods of water purification. This book is, therefore, a doubly welcome one.

The popularization of the results of scientific investigation is a difficult task. On the one hand is a mass of fresh information which needs only popular education to make it effective in practise; on the other hand is a large and intelligent public waiting for the information which it would gladly apply. The intermediary is still too often lacking because the qualities of scientific grasp and popular exposition are so rarely joined. On one side lies the pitfall of patronizing over-simplicity into which certain well-known authorities have recently so notably fallen. On the other side is the danger of being too technical, lacking in the clear analysis and telling exposition necessary to appeal to the untrained mind; this, if anything, is Mr. Hazen's error. His book is designed, as he states, especially for public officials who have been drawn from walks of life in which they have had no water-works experience and who wish to serve their cities well and can perhaps be aided in doing so by very simple statements as to certain matters. He modestly disclaims any intention of helping members of water boards and water-works superintendents, whom he believes to be familiar with the information which he gives. If the reviewer is not mistaken, however, the book will prove of very great value to the latter class of readers and will reach only exceptional individuals among the former. In a new edition, which is sure to be called for soon, the path to the solid knowledge the book contains might be made easier by a more logical arrangement of its contents and by the addition of two elementary chapters, one outlining, at the beginning of the book, the general characteristics of a good water-supply, and one, in the middle of the book, on the general plan and principles of water filtration.

In the present work the author begins with a detailed description of certain surface supplies. Then follows, in the next succeeding chapters, an admirable review of various sources of water supply, in which the grasp of trans-Atlantic conditions made possible by the writer's wide experience is tellingly evident. He discusses the use of large lakes for water supply and shows why Milwaukee and Duluth are comparatively free from water-borne typhoid, while Chicago and Cleveland have suffered so heavily. River waters are next discussed, and the ground is wisely taken that a certain amount of bacterial pollution is a necessary characteristic of surface waters and that the responsibility for the re-

moval of bacteria rests on the town drawing water from streams rather than on the community which discharges a reasonable purified sewage into them. In chapter five he points out the difficulty of securing good ground water supplies in America and contrasts this condition with that which obtains in northern Europe, particularly in Germany. It is evident that the water supplies of the United States must be drawn mainly from rivers and in this connection the author might well have emphasized somewhat more distinctly than he has done the modern dictum of sanitary science that no surface supply can be considered entirely safe for drinking without preliminary treatment. Filtered river and lake supplies must in the end offer the well-nigh universal solution of the water problem.

The question of tastes and odors in water is particularly well treated. Their origin is discussed in chapter one, a clear distinction being made between the odors of putrefaction produced at the bottom of reservoirs and the odors caused by the growths of organisms at their surface. The merits of stripping and of the copper sulphate treatment are conservatively handled and in chapter nine the removal of tastes and odors by filtration and aeration is discussed.

The subject of water filtration in general suffers a little, as pointed out above, by the lack of preliminary general statements, but the account of recent progress is excellent and the discussion of the possibility of securing a higher percentage purification than is obtained by sand filters to-day is eminently suggestive. Here, as elsewhere, the engineer can furnish any results for which it is worth while to pay.

The last six chapters of the book must be particularly commended; here, Mr. Hazen succeeds admirably in making complicated problems stand out clearly in their main outlines. In chapter eleven the fundamental engineering principles underlying construction, with its necessary allowance for excessive demands, and in chapter twelve the problem of securing adequate pressure, are excellently treated.

Chapter thirteen contains a good statement of the importance of metering water with a table which shows in a striking way the excessive consumption, in the neighborhood of 200 gallons per capita per day, in the large cities which have no meters, a wanton waste of water which is cut down more than three quarters by the installation of a considerable proportion of metered services.

Chapters fourteen and fifteen deal with the financial aspects of the water-works problem. Mr. Hazen estimates that the amount of money spent on construction and maintenance of water-works is no less than thirty millions per year and that, of this, something like one quarter is wasted by careless and inexpert methods. The problem of securing pure and wholesome water supply is a difficult one and requires technical expert service of a high grade.

It might be shown how in some lines of work the development is so rapid that even the most recent text-books are hopelessly out of date; how the subjects are becoming so complex that only the principles and not the important details can be treated in them; how the most efficient works are designed by groups of men, each attending to the parts which he best understands, and all under the general direction of a chief who has a clear idea of the end to be reached and the way of reaching it, though he may know less of many of the details than his subordinates; how the only way to learn a business is to be brought up in it; and how it can not be learned by a casual inspection from the outside.

Mr. Hazen rightly pays a tribute to the faithful, devoted and inadequately remunerated work of water boards and water superintendents at the present day, but his presentation makes it increasingly clear that the water supply problem is one of the many municipal questions which must be treated as technical engineering problems demanding expert service, properly rewarded, and unfettered by any demands other than those of economy and efficiency. The attainment of these ends will be furthered appreciably by a book so excellent, in the main, as Mr. Hazen's.

C.-E. A. WINSLOW

*Die Ausgleichungsrechnung nach der Methode der Kleinsten Quadrate.* By F. R. HELMERT, Director of the Royal Prussian Geo-

detic Institute. Leipzig and Berlin, B. G. Teubner. 1907. Second edition. Pp. xviii + 578.

In preparing the well-known first edition of this work Professor Helmert had in view the needs of the physicist, the astronomer and the geodesist rather than those of the mathematician; and, though the treatment of the subject was of necessity mathematical, the emphasis was not placed upon the more intricate parts of the mathematical theory. As a result the book gave a clear presentation of the *method* of least squares and supplemented it by a mathematical discussion which was ample for all ordinary purposes and which in some particulars went beyond the range of the ordinary texts on the subject. Numerous well-chosen problems furnished illustrations of the details of the use of the method in the chief cases.

The plan of the earlier part of the new edition is substantially that of the former one, though minor changes have been made. Nor does this adherence to the plan of a book thirty-five years old necessarily imply a defect in the new work. For the method of least squares is one of the few advanced branches of mathematical science in which such a proceeding is not inappropriate.

Certain features common to both editions deserve notice, and of these one is the treatment of the law of error. No conclusive argument in favor of this law has been given and the author has chosen to base it upon its accord with the results of observation. This is commendable, for it tends to clear a state of affairs which some one has characterized by saying of the law of error that both mathematicians and physicists accept it, the former because they believe the latter have obtained sufficient experimental evidence and the latter because they believe that it has been mathematically demonstrated. It is true that in the second edition one of the numerous mathematical arguments in favor of the law is included, but it is given a secondary place. Moreover, the author expressly considers several possible laws of error.

Clear explanations of the most important ideas of the subject are given early in the work and accompanying them are illustrations of their practical use. Then follows the development of the subject along standard lines from the discussion of direct observations of equal weight to that of indirect determinations of the values of quantities which are not independent.

Of the improvements made in preparing the new edition, one notes an increase in the amount of space devoted to pure theory, particularly in regard to the relations to each other of various kinds of errors of observation and in regard to the application of the method to interpolation. The size of the volume has been increased from 348 to 578 pages, and a large part of this increase is made up of the last three chapters, which deal with technical problems of physical, astronomical and geodetic work.

Pleasing are the frequent references to original sources and the excellence of the examples by means of which the theory is illustrated. A detailed table of contents and an index make all of the matter in the book accessible to the reader, and the publishers have made the book attractive in appearance. An occasional sacrifice of mathematical rigor for the sake of brevity will not prevent even an exacting reader from regarding the text as an excellent treatise on the subject.

George H. Ling.

Columbia University

## SCIENTIFIC JOURNALS AND ARTICLES

The opening (October) number of volume 14 of the *Bulletin of the American Mathematical Society* contains the following articles: "Application of a Definite Integral involving Bessel's Functions to the Self-Inductance of Solenoids," by A. G. Webster; "On the Apsidal Angle in Central Orbits," by F. L. Griffin; "The Maximum Value of a Determinant," by E. W. Davis; "The Invariant Substitutions under a Substitution Group," by G. A. Miller; Shorter Notices (Tannery's Leçons d'Algèbre et d'Analyse à l'Usage des Elèves des Classes de Mathématiques spéciales, Tome Premier, by F. Cajori; Tannery's Leçons d'Algèbre et d'Analyse, Tome Second, by G. W. Myers; Pionchon's Mathématiques.

Principes et Formules de Trigonométrie Rectiligne et Sphérique, by G. W. Myers; Schubert's Beispiel-Sammlung zur Arithmetik und Algebra, by G. W. Myers; Russell's Elementary Treatise on Pure Geometry, by O. Veblen; Bruns's Wahrscheinlichkeitsrechnung and Kollektivmasslehre, by H. L. Rietz; Engel's Hermann Grassmanns gesammelte mathematische und physikalische Werke, Band 2, by E. B. Wilson; Jaumann's Grundlagen der Bewegungslehre, von einem modernen Standpunkte aus, by G. W. Myers; Slocum's Text-Book on the Strength of Materials, by G. W. Myers); Notes; New Publications.

The November number (volume 14, number 2) of the *Bulletin* contains: Report of the Fourteenth Summer Meeting of the American Mathematical Society, by F. N. Cole; "On a Special Algebraic Curve having a Net of Minimum Adjoint Curves," by Virgil Snyder; "Note on Certain Inverse Problems in the Simplex Theory of Numbers," by R. D. Carmichael; "Third Report on Recent Progress in the Theory of Groups of Finite Order," by G. A. Miller; Notes; New Publications.

## SOCIETIES AND ACADEMIES

### THE TORREY BOTANICAL CLUB

The first fall meeting for the year 1907 was held on October 8, 1907, at the American Museum of Natural History. The meeting was called to order at 8:30 by the secretary, and Dr. E. B. Southwick was elected chairman. Eleven persons were present.

The announced program consisted of informal reports upon the summer's work and observations. In response to calls by the chairman the following members made remarks:

*Remarks on the Absence of Undergrowth in a Hemlock Forest:* C. Stuart Gager.

Hemlock seeds germinate freely under the parent trees, but seldom attain a height of more than three or four inches. It was suggested that there may be present in the soil a substance or substances secreted by the hemlock roots, and deleterious to the germination and growth of hemlock seedlings. This, as well as poor insolation, must be considered in attempting to explain why the seedlings fail to develop.

*Botanical Observations made in Pownal, Vt.:* M. A. Howe.

Dr. Howe reported his attendance at the annual summer field meeting of the Vermont Botanical Club, which was held in Pownal, the extreme southwestern township of Vermont. In this town are the only known Vermont stations for *Liriodendron tulipifera*, *Morus rubra*, *Aster sagittifolius* and several other species of interest.

*Plant Studies on the Northern Coast of the Gulf of St. Lawrence:* C. B. Robinson.

Dr. Robinson had spent the first two or three weeks of August at Seven Islands, on the northern coast of the Gulf of St. Lawrence, about 325 miles below the city of Quebec. The coast to the east of the bay of Seven Islands is a nearly level sandy plain, but the western side, and the islands across the mouth, are formed of steep crystalline rock, a kind of feldspar. A range of hills attaining 1,700 feet in height runs parallel with the coast about ten miles inland. With the exception of a few plants like *Sibbaldiopsis tridentata*, *Empetrum nigrum* and *Achillea millefolium* the rocks and the sand bore strikingly different floras. There was a tendency in some cases for the species of the woods to invade the sand, bringing there species like *Linnæa americana*, *Moneses uniflora* and *Peramium ophioides*. Three species of *Botrychium* grew in still more open places on the sand. The flora, at best a scanty one, is particularly poor in trees. The shores are lined by black spruce, and the white spruce is less common. Beginning a short distance from the shore, the sand plain becomes a pine barren, with *Pinus Banksiana* as practically the only tree. Two species of paper birch, the fir, larch, aspen and mountain maple are the only other real trees. It had been hoped that the higher latitude would sufficiently compensate for altitudes lower than those of the hills of Gaspé, and thus give a flora comparable with that of the latter. A few such species were found, among them *Diapensia lapponica*, *Vaccinium ovalifolium*, *V. uliginosum*, *Comandra livida*, *Euphrasia Ran-*

*dii* and *Selaginella rupestris,* but the general results in this respect were distinctly disappointing.

*Experiences at the Biological Laboratory of the U. S. Bureau of Fisheries at Beaufort, N. C.:* W. D. Hoyt.

An account was given of the excellent equipment of the station, and the facilities for research. The richness of the local fauna and the varied flora was noted. The locality abounds in epiphytic plants of numerous species. The speaker's investigations indicate a local algal flora that compares favorably with that of the New England and the Florida coast. Over 100 species have been found. The latitude of Beaufort appears to be the northern limit of certain southern species and the southern limit of some northern ones. The predominant flora varies greatly, according to the season, southern forms predominating in summer and northern forms in winter.

A coral reef about twenty-three miles off the coast and under a depth of 13 to 14 fathoms, extends about one mile in length and one half a mile in width. This is probably the most northern of the coral reefs. It supports a rich algal flora, consisting almost entirely of southern forms, and some of them new to North America.

*Remarks on the Unusual Habitats of Certain Ferns in New Jersey:* Miss Pauline Kaufmann.

Several species have been observed growing in habitats somewhat unusual for the species.

*Observations in Western South Carolina, and on the Isle of Palms:* Homer D. House.

On this island, which is off the coast of South Carolina, several species new to South Carolina, and a probably new species of *Helianthus,* were found.

*Account of a Visit to the Experimental Garden of President Brainerd, at Middlebury, Vt.:* Tracy E. Hazen.

A description was given of President Brainerd's experimental pedigreed cultures of violets. In addition to remarks concerning the Mendelian studies in *Viola,* attention was called to the fact that, contrary to the general notion, viable seeds were commonly found in the petaliferous flowers of the violet.

Discussion followed the remarks of each speaker.

C. Stuart Gager,
*Secretary*

## DISCUSSION AND CORRESPONDENCE

### SOME OBSERVATIONS ON MUSEUM ADMINISTRATION

The two articles which recently appeared in Science[1] by Drs. Dorsey and Boaz on museum administration have been of more than passing interest to those engaged in the collection and exhibition of natural history material. While Dr. Dorsey's article discussed the matter from a purely ethnological standpoint, that of Dr. Boaz is of such a scope as to include broadly all branches of museum installation. The following observations are based upon an experience of thirteen years in one of the smaller museums, where the attendance averages about 350,000 per year.

Dr. Boaz states that museums may serve three purposes, viz., healthy entertainment, instruction and the promotion of research. That a museum is for the purpose of providing instruction and of promoting research all museum men will agree, but there is great danger of dwelling too much upon the idea of entertainment. All museum men desire unquestionably that their museums should afford healthy entertainment, but the installations must not be prepared for this purpose. In the writer's opinion every exhibit should be prepared with some definite purpose in view; it must, indeed, be the embodiment of an idea which may be apprehended by the visitor.

It has not been the writer's experience that the public resents to any large degree an attempt at systematic instruction, or that it dislikes to give serious consideration to the exhibits. It has been frequently noted in the Chicago museums that visitors will study or look over every case in a given hall or gallery; the more commonplace exhibits will perhaps be passed over, but where it is apparent that some idea or fact of nature has been embodied in an exhibit, this exhibit will be carefully

[1] No. 641, April 12, 1907, and No. 650, June 14, 1907.

looked over and criticized. The writer does not believe that the majority of visitors to a museum are actuated by a mere search for entertainment. The public knows what the museum contains and it visits the institution because it desires to see the different kinds of animals, plants and minerals. If the visit was for the sake of mere entertainment, then surely the same people would scarcely visit the institution repeatedly.

Dr. Boaz asks the question, "What can be done for this class of visitors?" In answer to this I would call attention to the terse definition of Professor William H. Flower, who defines a museum as a place for the inculcation of ideas. We must not descend to the plane of the public's point of view and try to please it; we must, on the contrary, try to lift it up to higher planes of thought. Nature presents countless facts for our use and we have but to utilize them to find an inexhaustible mine of "healthy entertainment" at our command. The idea of making exhibits "popular" is receiving more attention of late than the subject demands. In the writer's opinion the popularity of an exhibit should not be the motive governing its construction. Each exhibit should crystallize about some central thought or fact, so presented, in either label or preparation, as to fix the thought in the mind of the visitor. There will be, unquestionably, a number of people who will fail to perceive this central idea, but I am positive that the majority of visitors will apprehend the lesson which the exhibit seeks to teach. The writer's experience has been that the museum visitors minutely inspect a group exhibit, searching for those little artistic touches which make the modern groups so interesting. To cite an example; we have in the Chicago Academy of Sciences a large group of Virginia deer, showing this species in a Wisconsin forest. It is called a "woodland courtship" on the label and presents two bucks fighting for the possession of the female. In the same exhibit are several chickadees, a red squirrel, a woodpecker and a porcupine, besides some snail shells near a pool of water. Several of these animals are hidden by foliage, but the sharp eyes of some visitor invariably spies them and such exclamations are heard as "Oh, see the squirrel!" "Look at the little bird hanging by his feet!" (referring to one of the chickadees) or, "See the woodpecker behind the tree!"

The public comes to the museum with several definite questions which it seeks to have answered. These are, what is the object? where did it come from? What is it good for? All of these questions may be answered by specially prepared exhibits and labels. It is astonishing to note with what avidity the museum visitor studies a group which has been prepared to illustrate some common aspect of nature. A year or more ago the Chicago Academy of Sciences began the preparation of a collection of Illinois birds mounted in small groups to show their nesting habits as well as their young. With each group a map was placed, showing the breeding, the winter and the migration range of each species. These cases are emphatically popular, although they were not prepared for entertainment but for study.

As a rule the large museum makes the very serious mistake of exhibiting too much material and the visitor is bewildered, tries to "do" the whole museum in one visit and leaves it with an aggravated case of brain fag. The writer has always contended that a natural-history museum should divide its collections into two parts, one of which is specially arranged for the museum visitor, while the other is especially prepared for the convenience of the serious student, who will be, as Dr. Boaz remarks, in the minority. The endless exhibition of species and genera is very tiresome to the museum visitor, to whom they all look alike. If, however, a selection be made to bring together a few of each family to show their interrelationship and their contrasts, then the visitor is interested. Such exhibits as the typical inhabitants of different countries, those peculiar to certain regions or those which have an economic value are always interesting to even the most casual visitor.

It is doubtless true, as Dr. Boaz states, that the label is quite secondary to the specimen, which is the essential thing. The visitor looks for the specimen first and then looks for

the label, and if the latter is not there, then the visitor, if he is from Chicago, will hunt up the first available attendant and ask what the name of the specimen is. This experience has been repeated a thousand times in the museum under the charge of the writer. This shows clearly that a good label is an important item. It has been stated by some museum men that the public will not read labels, but here again the writer's experience, both in his own institution and while visiting the museums in New York and Washington, is at variance with this statement, for of the visitors actually seen fully seventy per cent. read some of the labels. This presupposes, of course, that the labels are printed or are written in a legible manner.

For purposes of instruction it is obviously impossible to arrange large collections from all points of view, nor is this necessary, because the teacher will select from the exhibit material those sections which best illustrate the problem at hand. The possibilities of variation in systematic exhibition are endless and it requires an administrator with positive genius to successfully travel the middle road. The large museums, however, should aim to have systematic collections in all branches, sufficiently exhaustive to clearly indicate our present knowledge of the science. This does not mean, of course, that every known species and variety shall be exhibited, but that enough shall be available to the public to indicate the advance in each particular branch of science. The public expects this and should not meet with disappointment.

It is a mistake to prepare large exhibits primarily for the schools, because each school will use the collections for a different purpose and in a different manner and the selection of material must be left to the teacher. It is becoming apparent to some museum men that each school must possess its own small and selected museum with which to teach the principles of science, and the larger museum will be ultimately used as an adjunct to the school museum when the pupil is able to more easily grasp the significance of the larger exhibits. This plan is now being successfully carried out by several Chicago schools and these schools have also successfully demonstrated that concentration of thought can be secured in a large hall which is used by the public and which is as systematically arranged as it is possible to make a collection.[2]

It is probably true that the smaller museums are in closer touch with the schools and with the public than the larger museums are. This may be due to the fact that the collections are more concentrated and hence more available for systematic study. It has seemed to the writer that an expansion of the systems in use by the smaller museums would make the larger museums much more useful to the schools as well as to the general public. The writer can by no means agree with the statement made by Dr. Boaz that a thorough systematization of the large museum is impossible or that systematic museums must of necessity be small. A museum, large or small, without a thorough systematization would be an absolute failure and of little value for scientific study. There seems also, to the writer at least, too much concern about the seeming conflict between the interests of the public and of the scientist. There should be no conflict if once we divorce ourselves from the idea that we must of necessity try to please the public. Visitors will crowd the museum halls no matter what is exhibited or its manner of exhibition, and it lies with the museum administrator to arrange and install his collections for the best interests and for the advancement of science, for which reason alone the museum is in existence. The principal function of museums, large and small, is the acquisition and preservation for future study of such material as will throw light upon the great problems of life which confront us and which are engaging our attention. The exhibition of material is secondary to this great work. In the near future more of the larger museums will doubtless follow in the footsteps of the National Museum and select broad-minded men as curators of exhibits, leaving the specialists free to carry on their studies.

In conclusion the writer wishes to state as

[2] See the *Museums Journal* for August, 1905, p. 50.

his opinion that the public should be rigidly excluded from the study collections. These should, if possible, be kept away from the exhibition halls, but if this can not be done they should at least be kept from the public view. Drawers with glass tops, placed beneath the cases and accessible to the public are an abomination to the curators and a menace to the safety of the collections, besides serving no good purpose to the public, which is only bewildered by the multitude of similar forms.

The paper by Dr. Boaz opens up some perplexing but also interesting questions of museum administration and it would be of value to hear from others who are working along this line. Many of the problems touched upon will probably be discussed by the American Association of Museums at some of its future meetings, and the writer would suggest that the Chicago meeting in 1908 will be an opportune time to offer some of these problems for debate.

FRANK C. BAKER,
*Curator*
THE CHICAGO ACADEMY OF SCIENCES

THE PUBLICATION OF AGRICULTURAL RESEARCH

PROFESSOR WEBBER in a recent issue of SCIENCE[1] has crystallized a problem which has been prominent in the minds of experiment-station workers of the United States for the last decade or more, and which has been particularly accentuated by the recent expansion of technical work in the stations by virtue of the Adams Act.

Most active station workers feel the need of additional and better facilities for publication.

As Professor Webber indicates, the issuance of special technical series of bulletins has been a failure and has been almost entirely or altogether abandoned. The publication of a technical bulletin with another edition of the same number in popular abstract, tends to confusion. Some stations issue the more technical, less practical, bulletins in small editions and withhold them from general distribution. This course is objectionable, since the farmer feels slighted when he finds that certain bulletins have not been sent to him. To take the other horn of the dilemma and send all of this technical matter to the farmer, placing before him matter which will ultimately and in the hands of the proper persons be highly valuable, but which it is entirely impossible for him to use or even to judge properly, is certainly not a proper course.

Nor do any of these methods of bulletin publication of technical matter attain the desired end, viz., *to reach the largest number of interested people and to place the matter in permanent and easily accessible form.*

In general, the plan of Professor Webber must meet approval in that it provides a central unified publication center. Personally I believe that there should be one publication which might be known as the *Journal of American Agricultural Research,* a title which commends itself as being definitive and concise, and which is easily abbreviated to *J. A. A. R.* or *Jour. Amer. Agric. Res.,* an abbreviation which is not preempted in the large list used by the *Experiment Station Record.* While primarily intended for publication of the research of experiment-station workers, who should have the first right to immediate publication, the privileges might be extended to all other research concerning American agriculture.

This journal should be issued in numbers consecutively, as they come from the press and be paged consecutively as high at least as the ten-thousandth page. All citations by page will then be exact. The numbers should be of variable size to conform to the dimensions of the single articles contained therein, and such editorial staff and press facilities should be at command as to insure practically immediate publication of matter submitted to the editorial board by various station directors.

Frequent index numbers with extensive cross reference should be issued in order to keep the journal of ready reference utility. Such a journal used in conjunction with the *Experiment Station Record,* as at present conducted, would render all American agricultural research readily accessible.

[1] SCIENCE, Vol. XXVI., p. 509.

I see no need, and indeed it seems to me a great disadvantage, to divide the publication into separate series. Each experiment station and each other large research institution, many libraries and many individuals, will desire the whole publication. Citation should be to the journal as a whole and not to separate series. If division into series be attempted their boundaries will be artificial and their number will be constantly changing and no stability will be secured.

Issuance in series will also inevitably lead to delay. The only advantage of such a series will be that each investigator may receive only the series concerning his particular field. This end may be attained with even greater accuracy by issuing each article as a special number of the journal, and sending to subscribers only such numbers as contain articles pertinent to the subscriber's interest. In this I incline to the view expressed by Bailey[2] and avoid the difficulties raised by Gilmore[3] and by Webber himself.

If there be no separate series of the journal the editorial board would need to be enlarged to include one or more men in each special field of research. These editors should be paid sufficient compensation to make it their duty to give *immediate attention* to each article submitted to them, and thus to facilitate publication.

Numbers upon designated subjects should be sold to station workers at a price sufficient to control actual waste, but low enough to be without burden to the subscriber, as, say, 25 per cent. of actual cost.

F. L. Stevens
*Vegetable Pathologist*
N. C. Experiment Station

### HOLOTHURIAN NAMES

To the Editor of Science: In reference to the letters by Dr. Theo. Gill and Dr. W. K. Fisher in Science for August 7 and September 20, respectively, I would ask whether Dr. Fisher's conclusion that "we can no longer speak of sea-cucumbers as 'holothurians,' nor of the class as *Holothurioidea*" is really justified.

[2] Science, Vol. XXVI., p. 512.

[3] Science, Vol. XXVI., p. 511.

Even if the name *Holothuria* be taken up by the writers on Cœlentera, is there any reason why we should not continue the use of what has now become an ordinary English word? And as regards the name of the class, I would protest against the assumption that this must necessarily be based on the name of one of the families or one of the genera included in the class.

It is generally held that the word ὁλοθούριον, used by Aristotle ("Historia Animalium," I., i., 19, and "Partes Animalium," IV., v., 43), as well as the word *Holothurium*, used by Pliny ("Naturalis Historiæ," Liber I., Cap. xlvii.), refer to a sea-cucumber. This is surely enough to justify the continued use of the class name Holothurioidea.

Since in these days the genus *Holothuria* has become so much split up that it would in any case be difficult to decide for which of its sections the name *Holothuria* should be retained, the disappearance of the name from systematic usage is by no means to be regretted. As for the possible transference of the name *Holothuria* to either a pelagic hydroid or a tunicate, this appears to be eminently one of those cases which should be disposed of by an international committee, such as it was proposed should be established by the International Zoological Congress. I am not aware whether such a committee was actually appointed.

Both your correspondents seem to have overlooked the fact that the absurdities following a rigid adherence to rule in this matter were well put by my colleague Mr. F. Jeffrey Bell in his note "A Test Case for the Law of Priority" (*Annals and Magazine of Natural History*, pp. 108–109; July, 1891).

F. A. Bather
London

## SPECIAL ARTICLES

### A SUGGESTION FOR A NEW UNIT OF ENERGY[1]

The study of the food of man and of animals as a source of energy to the organism has made rapid progress within recent years. It is, of course, easy to overestimate the value

[1] Read before the Society for the Promotion of Agricultural Science at its annual meeting, May 27, 1907.

of a new method or a new point of view, and we must beware of assuming that a study of food energy will solve all the problems of nutrition. At the same time, the new method, while not a panacea, has proved a most useful instrument which seems likely to be employed to an increasing extent.

The unit of energy commonly employed in such studies is either the large or small calorie. This arises naturally from the fact that in order to measure the quantities of energy involved we ordinarily convert them into heat. The use of the calorie as a unit is, therefore, convenient in avoiding a recalculation of results, in spite of its unfortunate suggestion that we are dealing with energy in the animal body in the form of heat only.

In practical use in connection with the feeding of domestic animals and the computation of their rations, however, the calorie is an inconveniently small unit. To express the energy values of feeding stuffs per pound in kilogram calories requires rarely less than three integers and usually four, while the energy values of rations computed per 1,000 pounds live weight, as is the usual custom, practically never require less than five integers. Taking, for example, the maintenance requirement, which is about the smallest quantity of energy which we need to express in practise, the average of Kellner's determinations for cattle is 13,469 calories of metabolizable energy per head, or 21,312 calories per 1,000 kgs. A ration for productive purposes, of course, would require the use of still larger numbers. These large numbers are inconvenient in computation, and differ so much in appearance from those which have previously been used that it is likely to be difficult to bring them into common use.

To meet this difficulty Kellner has proposed the use of "starch values" to express the production values of feeding stuffs as determined according to his method. The starch value of a feeding stuff means, in brief, the amount of pure starch which would produce the same energy effect as a unit weight of the feed in question. Computed per 100 units, the starch values give figures comparable with the percentages of total digestible matter heretofore used, commonly requiring two integers for their expression.

There are, however, certain objections to this method of expression, and to the writer it seems preferable, if we are to attempt to deal with energy values at all, to do so boldly and to employ a unit of energy rather than a unit of matter. To do so conveniently, as already indicated, it is desirable to have a larger unit, and the object of this paper is to suggest such a unit for discussion and to indicate by one or two examples how it could be used.

The unit which I suggest is 1,000 kilogram calories, for which I propose the designation *Therm*. The word therm has already been proposed as the equivalent of the small or gram caloric, but does not appear to have come into general use. Following the analogy of the calorie, we may write the unit here proposed with a capital and use the capital or full-face **T** as a convenient abbreviation. The relation of the units would then be

| | |
|---|---|
| 1 therm (t) | = 1 gram-calorie (cal.). |
| 1,000 cals. | = 1 kilogram-calorie (Cal.). |
| 1,000 Cals. | = 1 Therm (**T**). |

While a sense of strangeness and awkwardness of course attaches to the proposed as to any new term, it seems better, if a new unit is to be used at all, to give it a new name rather than to employ any modification of the word calorie, which would be likely to produce confusion. It may be objected that the suggested unit is not a C.G.S. unit, but while this is true, a thermal unit is practically more convenient, partly because, as already pointed out, our determinations of energy are usually made in thermal units and in part because any available C.G.S. units are rather small.

As an example of the use of the suggested new unit, I have taken three samples of feeding stuffs whose energy values have been determined at the Pennsylvania Experiment Station, namely, timothy hay, clover hay and corn meal. The composition and digestibility of these feeding stuffs per 100 pounds as expressed by the ordinary method, and also the energy values of the same quantity, are shown in the following table:

*In 100 Pounds*

| | Timothy Hay. Pounds | Clover Hay. Pounds | Corn meal. Pounds |
|---|---|---|---|
| *Composition* | | | |
| Water | 15.00 | 15.00 | 15.00 |
| Ash | 3.94 | 5.58 | 1.23 |
| Proteids | 4.34 | 9.50 | 8.67 |
| Non-proteids | 0.20 | 0.76 | 0.25 |
| Crude fiber | 33.08 | 24.46 | 1.86 |
| Nitrogen-free extract | 41.67 | 42.21 | 69.40 |
| Ether extract | 1.77 | 2.49 | 3.59 |
| | 100.00 | 100.00 | 100.00 |
| *Digestible nutrients* | | | |
| Proteids | 1.57 | 5.13 | 5.76 |
| Carbohydrates | 44.06 | 42.24 | 68.44 |
| Fat | 0.63 | 1.59 | 3.44 |
| | 46.28 | 48.96 | 77.64 |
| *Energy* | | | |
| Fuel values | 77.70 **T** | 80.17 **T** | 132.68 **T** |
| Maintenance values | 48.89 " | 58.54 " | 103.30 " |
| Production values | 25.87 " | | 70.72 " |

The maintenance values of feeding stuffs will seldom require more than two integers for their expression in the new unit and the production values, I think, never. Expressed in this way, these values have quite the appearance and effect of percentages. It is true that if expressed per 100 kgs. instead of per 100 pounds the numbers would be somewhat unwieldy, but the actual adoption of the metric system in this country still seems distant. The reason for expressing the values per 100 pounds instead of per pound will appear if we consider the use of these figures in the computation of rations.

As a simple case let us suppose we have a ration consisting of 12 pounds of timothy hay and 18 pounds of corn meal, and that we desire to compute its production value on the basis of these tables.

The ordinary method of computing the digestible nutrients is illustrated in the first half of the subjoined table. The calculation is identical with the one with which we are already familiar, with the single exception that the number of pounds of the feeding stuff is expressed as a fraction of 100 pounds. In other words, the transposition of the decimal point is made in this number and not in the figures for the percentages.

The second portion of the table shows the computation of the ration on the basis of its energy value. But a glance is needed to show that the two are precisely similar and that the units of energy can be handled in this way in a manner precisely analogous to the manner in which protein, carbohydrates and fat are handled.

The total ration, therefore, would be as tabulated in the second table.

| | Timothy Hay. Pounds | Corn meal Pounds |
|---|---|---|
| *Digestible nutrients* | | |
| Dry matter | 85.00 x 0.12 = 10.20 | 85.00 x 0.18 = 15.30 |
| Digestible | | |
| Proteids | 1.57 x 0.12 = 0.19 | 5.76 x 0.18 = 1.04 |
| Carbohydrates | 44.08 x 0.12 = 5.29 | 68.44 x 0.18 = 12.32 |
| Fat | 0.63 x 0.12 = 0.08 | 3.44 x 0.18 = 0.62 |
| Total | 46.26 5.56 | 77.64 13.98 |
| *Production values* | | |
| Dry matter | 85 00 x 0.12 = 10.20 | 85.00 x 0.18 = 15.30 |
| Digestible | | |
| Proteids | 1.57 x 0.12 = 0.19 | 5.76 x 0.18 = 1.04 |
| | Therms | Therms |
| Production value | 25 87 x 0.12 = 3.10 | 70.72 x 0.18 = 12.73 |

*Computed Ration*

| | Dry Matter | Digestible Proteids | Production Value |
|---|---|---|---|
| 12 lbs. timothy hay | 10.20 lbs. | 0.19 lb. | 3.10 **T** |
| 18 " corn meal | 15.30 " | 1.04 lbs. | 12.73 " |
| | 25.50 " | 1.23 " | 15.83 " |

Finally it should be noted that it is not the relative value of these two methods of expressing the content of feeding stuffs or rations which is here in question. Assuming the desirability of the use of units of energy, the purpose is to show that the manner of using them according to this scheme is quite similar to the familiar methods of computing rations, so that the transition from one system to the other should be comparatively easy, while the use of large figures is avoided. The writer would be grateful to receive the fullest criticism, both in general as regards the utility of such a unit and specifically as to the suitability of the one proposed and the propriety of the name suggested.

HENRY PRENTISS ARMSBY
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## THE FLYING MACHINE

THE fact that a machine of the aeroplane type built entirely of metal and canvas may be made to fly by the power of an ordinary

steam engine judiciously constructed, was practically demonstrated some time ago by S. P. Langley. More would, therefore, be expected from the gas engine, if constructed with equal forethought. I have always had some misgivings, however, as to whether these experiments, into which so much devoted labor was put, actually met the real issue involved. It seemed to me that they proved that the power available in case of the ordinary engine is just about sufficient to maintain flight and no more; whereas a really practical machine should be provided with a motor whose output of work per second and per kilogram of weight, could be made enormously to exceed the demands upon it, under conditions of smooth soaring.

If one is in search of a maximum of power combined with a minimum of weight, one involuntarily looks to some form of modern explosive and in particular to those which can be worked up into wicks or ribbons. These could be adapted for use in connection with the rocket principle which has so frequently stimulated the imagination of inventors, in a way to require the least amount of subsidiary mechanism. In fact, such expansion is virtually its own propellor. The only question is, how can this quite prohibitively excessive power be controlled. In other words, how may the enormous per second expenditure of energy be reduced in any desirable amount at will, and compatibly with safety and the need of the operator?

Now it occurred to me that in case of the nitrogen explosives there may be a method of obtaining a continuity of power values within safe limits from insignificant amounts up to the highest admissible, by using some appropriate method of very cold storage. It is well known that at sufficiently low temperatures phosphorus and oxygen cease to react on each other, that fluorine is indifferent to hydrogen, etc. Is it not, therefore, probable that an explosive tendency will be toned down as temperature decreases; or that a molecular grouping which is all but unstable at ordinary temperatures will become stable at a temperature sufficiently low, and proportionately stable at intermediate temperatures. This is then the experiment which I would like to see tried, the endeavor to get a gradation of power values ending in prohibitively large maximum, by the cold storage of explosives. If it succeeds, it seems to me that a motor yielding per pound weight not only all the power needed in the flying machine under any emergency will be forthcoming, but that large amounts of the inevitably dangerous source of such power may be taken aboard for use en route. The lower temperature of the upper air would here itself be an assistance.

Carl Barus

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## *ABSTRACTS FOR EVOLUTIONISTS*

### ANTARCTIC APTERA

Professor George H. Carpenter has recently published[1] a report on the Collembola of the South Orkney Islands, obtained by the Scottish national Antarctic expedition. In describing *Isotoma brucei* n. sp. he remarks that it is closely related to the Arctic and subarctic *I. beselsii* Packard: "In the general build of the body and the structure of the spring—particularly the form of the mucro, with its three prominent claw-like teeth—these two species of *Isotoma* stand apart from all other members of the genus." After discussing the distribution of the Antarctic Collembola, Professor Carpenter arrives at the conclusion that the ancestor of *I. brucei* must have reached the Antarctic lands during the secondary period, and that during all the time that has since elapsed, it has undergone no more modification than is expressed by the difference between *I. brucei* of the south and *I. beselsii* of the extreme north—a difference of much less than generic value.

### UNIONIDÆ OF THE LARAMIE CLAYS

It is well known to naturalists that the eastern United States are the home of numerous remarkable groups of fresh-water mussels, which are absent from the western part of the continent, and to all appearances orig-

[1] *Proc. Roy. Soc. Edinburgh*, XXVI., Part VI. (1906).

inated in the same general region as that in which they now occur. Dr. R. P. Whitfield has published[2] accounts of a number of species of *Unio,* in the old broad sense, which have been obtained in the Laramie beds of Montana, and has called attention to their great resemblances to some of the more characteristic forms of the Mississippi and Ohio valleys. Placing these in their modern genera we find:

*Unio gibbosoides* Whitf. resembles *gibbosus* Barnes.

*Pleurobema æsopiformis* (Whitf.) resembles *æsopus* Green.

*Obliquaria letsoni* (Whitf.) resembles *cornuta* Barnes.

*Quadrula cylindricoides* (Whitf.) resembles *cylindrica* Say.

*Quadrula pyramidatoides* (Whitf.) resembles *pyramidata* Lea.

*Quadrula verrucosiformis* (Whitf.) resembles *verrucosa* Barnes.

*Obovaria retusoides* (Whitf.) resembles *retusa* Lam.

Thus several genera are represented, and as to the species, Dr. Whitfield says "some of them are so nearly like the living species, that it would do but little violence to specific features to state that they were the same." In view of these facts he adds: "I venture to state that these further western waters of the Laramie times were the original home of much of the *Unio* fauna of these [Mississippi and Ohio valleys] more eastern recent localities."

### AN ANCIENT TYPE OF TREE

The *Ginkgo,* now commonly planted in the states along the Atlantic coast, is of interest to all botanists on account of its curious foliage, and especially because it is the last surviving member of a very ancient and at one time widespread genus. Miss M. C. Stopes, in a description of the flora of the Inferior Oolite of Brora, Scotland,[3] points out that the *Ginkgo digitata* (Brongn.) of those beds is so like some examples of the living *G. biloba* that at first sight no difference can be observed. However, by great good fortune the epidermis of some of the specimens of *G. digitata* is well preserved, and shows cells with even outlines, whereas in *biloba* the outlines of the cells are mostly wavy, the difference being considered of specific value.

### HYBRID HUMMING BIRDS

Messrs. John E. Thayer and Outram Bangs have lately published[4] a short paper on hybrid humming birds, of which four are now known from California alone. These, occurring, of course, in the wild state, are all between different genera; but the genera in this group are many of them very closely allied. The fact and character of the hybridization in each case is determined wholly from a study of the skin, but the authors seem confident of their results. The presumed hybrids are:

*Selasphorus alleni* × *Calypte anna.*
*Trochilus alexandri* × *Calypte anna.*
*Trochilus alexandri* × *Calypte costæ.*
*Selasphorus rufus* × *Atthis calliope.*

### CRESTED TITMOUSE HYBRIDS

*Bæolophus bicolor,* the tufted titmouse, ranges from the Atlantic coast to the Great Plains. *B. atricristatus,* the black-crested titmouse, ranges from the highlands of Vera Cruz to central Texas. At the line of junction of the humid and arid divisions of Texas these birds meet one another, and all sorts of intergrades occur. Dr. J. A. Allen has made an elaborate study[5] of these Texas forms, based on more than 200 skins, and arrives at the conclusion that it is a case of hybridization, not of geographical gradation. "The same localities furnish, at several known and quite widely separated points, birds of pure blood of both species, and intergrades having almost every possible combination of the strikingly dissimilar features of the two species." There is a genuine geographical variation in size observable in both species; the larger northern race of *B. atricristatus* is

[2] *Bull. Amer. Mus. Nat. Hist.,* XIX., and especially XXVI. (1907).

[3] *Quart. Journ. Geol. Soc.,* August 14, 1907.

[4] *The Auk,* July, 1907, p. 312.

[5] *Bull. Amer. Mus. Nat. Hist.,* XXIII., separates dated June 12, 1907.

separated as *B. atricristatus sennetti* Ridgway; the small Floridian form of *B. bicolor* has been named *B. bicolor floridanus* Bangs; while the maximum of the same species, found in eastern Kansas, could be called *B. bicolor missouriensis* (*Parus missouriensis* Baird) if it were worthy of a name, which Dr. Allen thinks doubtful. These differences are clearly geographic and are apparently dependent upon climate, directly or indirectly. It is quite possible that in part, at least, they represent what Tower calls "place-variation." In both species there is some difference in color accompanying that of size, and in the case of the black-crested titmouse this is quite marked. If the birds can be readily bred in captivity, they afford a fine opportunity for experimental work.

### AFRICAN ISOPODS

IN a descriptive account[6] of the terrestrial Isopod Crustacea collected in Liberia by Dr. O. F. Cook, Miss Harriet Richardson describes four species of the genus *Ethelum* Budde-Lund, stating that "all the species of this genus hitherto described are from the West Indies." It is interesting, as showing how little we know about tropical Isopods, to find that all the species of Eubelidæ collected by Dr. Cook, twelve in number, were new to science.

T. D. A. C.

[6] *Smithsonian Misc. Coll.*, September, 1907.

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## *BOTANICAL NOTES*

### SUNDRY BOTANICAL PAPERS

ELMER D. MERRILL, of the Biological Laboratory of the Bureau of Science, at Manila, has published in a recent number of the *Philippine Journal of Science* an interesting account of the flora of Mount Halcon on the island of Mindoro. He confines his paper to the spermatophytes, the vascular cryptogams having been catalogued by Copeland in an earlier number of the same journal. One species of *Agathis* (*Pinaceae*), three of *Dacrydium*, eight of *Podocarpus*, and one of *Phyllocladus* (*Taxaceae*) make up the list of gymnosperms. But nine species of grasses are recorded, including one *Bambusa*. The sedges are scarcely better represented, having but ten species in the list, only one of which is a *Carex*. Of the palms there are but two species. The families *Juglandaceae, Fagaceae* and *Ulmaceae* are represented respectively by single species of *Engelhardtia, Quercus* and *Gironniera*. Of the *Rosaceae* and *Leguminosae* there are but three species each, while there is but one umbellifer. Even the great family *Compositae* is represented by only nine species. The largest family is the *Rubiaceae* with 27 species, followed with *Melastomaceae* (18), *Taxaceae* (12), *Myrsinaceae* (12), and curiously enough, the *Ericaceae* also with 12 species. In the latter there are two species of *Rhododendron,* one of *Gaultheria* (subscandent!) and eight of *Vaccinium* (mostly epiphytic!).

In the September *Botanical Gazette* Mary S. Young publishes an interesting short paper on the germination of the pollen of *Dacrydium,* one of the *Taxaceae*. The material was obtained in New Zealand.

Mr. Ellsworth Bethel, of Denver, and Dr. W. C. Sturgis, of Colorado Springs, have projected a series of papers to be published under the general title of "The Myxomycetes and Fungi of Colorado." The first number has appeared in the "Colorado College Publication" for September, and is entitled "The Myxomycetes of Colorado." It was prepared by Dr. Sturgis. He does not attempt to determine whether these organisms are plants or animals, "nevertheless," he says, "the study of these organisms is, and always has been mainly in the hands of botanists." After a few paragraphs on their structure, collection and preservation, microscopic examination, and literature, he gives a key to the genera known to occur in Colorado. This is followed by a fully annotated list of the species arranged under their genera. No attempt is made to characterize the genera otherwise than is done in the key, and only new and hitherto unreported species or varieties are described. About one hundred species and varieties are included.

"Linné and the Love for Nature" is the title of a pretty and appreciative paper by

Edward K. Putnam read at the Augustana College celebration of the two hundredth anniversary of the birth of the great Swedish botanist. It has now been published in *The Popular Science Monthly* (October, 1907).

Dr. C. L. Shear publishes a valuable bulletin (No. 110 of the Bureau of Plant Industry, U. S. Department of Agriculture) on "Cranberry Diseases." In it he brings together what he has hitherto published in smaller papers, and thus makes the first full account of the diseases of the cranberry due to fungi. It is illustrated by seven full-page plates, two of which are colored. The diseases discussed at length are "scald" (due to *Guignardia vaccinii*), "rot" (due to *Acanthorhynchus vaccinii*), "anthracnose" (due to *Glomerella rufomaculans vaccinii*) and "hypertrophy" (caused by *Exobasidium oxycocci*). Thirteen additional species of fungi attacking the fruit and producing diseases of less importance receive briefer treatment, while seventeen more occurring on leaves or stems are noticed and still more briefly discussed. Several pages are devoted to preventive and remedial measures. A bibliography of cranberry diseases including sixty titles closes this important paper.

Dr. H. L. Shantz's "Biological Study of the Lakes of the Pike's Peak Region" in the *Transactions of the American Microscopical Society* (Vol. XXVII.), although largely given to a description of the zoological phase of the matter is a valuable paper for the botanist who is interested in plankton studies. Dr. Shantz brings out many interesting facts in regard to the vegetation of a dozen or more lakes ranging from 1,800 to over 3,300 meters above sea level.

Professor Stanley Coulter and Herman B. Dorner, of Purdue University, have issued a handy "Key to the Genera of the Native Forest Trees and Shrubs of Indiana" which must prove very helpful to pupils and teachers in the public schools, as well as to some college students. The key is of the strictly dichotomous kind, and so while quite "artificial" is very easily used. Two plates and a two-page glossary complete the duodecimo, 24-page pamphlet. It is supplied to schools for twenty cents.

A useful 80-page bulletin (No. 107), prepared by Alice Henkel, has just been issued by the Bureau of Plant Industry (U. S. Department of Agriculture) under the name of "American Root Drugs." From it we learn that "more than half of the root drugs in the Eighth Decennial Revision of the United States Pharmacopoeia occur in this country, some native and not growing elsewhere, and others introduced." In all fifty such drugs are described, and with the description of the drug there are given botanical and common names, habitat and range, description of the plant, with notes as to cultivation, collection, prices, and uses of the drug. Twenty-five text figures and twenty-eight reproductions of photographs of as many plants serve to make this paper still more useful.

Under the title of "The Roots of *Lycopodium pithyoides*" Alma G. Stokey describes in the July *Botanical Gazette* the curious phenomenon of the formation of "inner roots" which run down *inside* of the stem, boring their way through the cortical tissues, and finally emerging at or near the base of the stem.

In a recent paper Dr. R. P. Hibbard gives (*Botanical Gazette,* June, 1907) the results of his experiments made to determine the effect of prolonged tension upon the formation of mechanical tissue in plants. By ingenious devices he subjected stems and roots to tension and compression. The results showed that the response of the plant was generally not great, although usually noticeable.

From his investigations of pollen formation in Cucurbitaceae (*Bulletin Torrey Botanical Club,* Vol. 34, pp. 221–242) J. E. Kirkwood is able to confirm the conclusions of other observers, and to add somewhat to our knowledge of the karyokinetic stages.

One of the best attempts to formulate the work in botany for the high schools is that of Professor R. Kent Beattie, of the Washington State College. It is issued by the State Superintendent of Public Instruction as High

School Bulletin No. 1, and is intended to serve as a guide for the high schools of the state. The work as outlined includes the cell, the blue-green algae, the green algae, the lower fungi, brown seaweeds, higher green algae, red algae, higher fungi, liverworts, mosses, ferns and their allies. This is followed with sixteen lessons on the structure and activities of the seed plants and suggestive paragraphs on how to make a botanical museum and herbarium, how and what apparatus to buy, a list of text- and reference-books, etc., etc. It must prove very helpful to high school principals and those who are teaching botany in these schools.

ANOTHER TREE BOOK

MR. ROMEYN B. HOUGH, well and favorably known in connection with his publication of sections of American woods, has issued a stout volume of 464 pages under the title of "Hand-book of the Trees of the Northern States and Canada east of the Rocky Mountains." In this book one finds for each of the more than two hundred species included, on one page a reproduction of a photograph of the leaves, twigs and fruit, and on the page opposite, a similar photograph of the trunk, a map showing distribution, a careful description, and in many cases an enlarged photograph of a cross-section of the wood. The photographs are admirably selected, and have been reproduced very successfully. Those showing leaves and fruits are upon a background marked into squares which originally were square inches, and so while the pictures have been reproduced with different degrees of reduction, the lines enable one at once to make out the actual dimensions of the objects. This device is very ingenious, and should be more generally adopted by book-makers. The little maps are admirable, and tell more exactly the distribution of each species than is possible by any amount of mere description.

At the beginning of the volume is a key to the families, based mainly upon the flowers, and in the back portion is given a synopsis of the families and genera, with keys to the species. Here occur also the descriptions of a considerable number of species not found in the illustrated part of the volume. The book closes with a full glossary, and a well-arranged index. It will be indispensable to the botanist, and the student of forestry.

CHARLES E. BESSEY
THE UNIVERSITY OF NEBRASKA

## APPOINTMENTS AT TULANE UNIVERSITY

THE following changes are noted in the faculty of the Tulane University of Louisiana for 1907–8:

Dr. Robert Sharp, head of the department of English, has been granted a year's leave of absence, and has selected as his substitute Mr. Armour Caldwell, of Columbia and Harvard, who with Assistant Professor Brown, of the department of English, will carry on Dr. Sharp's work for the present session.

Dr. Ulrich B. Phillips, assistant professor of American history in the University of Wisconsin, who has been granted a year's leave of absence by that university, has been selected to fill the chair of history, made vacant by the death of Professor John R. Ficklen.

Professor J. M. Gwinn, professor of pedagogy in the Missouri State Normal School, at Warrensburg, has been appointed to the newly-established chair of education.

Dr. John C. Ransmeier, who recently returned from Europe, where he has been traveling on the John Harvard fellowship, has been appointed assistant professor of German, vice Professor John Hanno Deiler, who retired last June on a Carnegie pension.

Dr. William B. Smith, former professor of mathematics, who spent the most of last year in Europe, will fill the chair of philosophy. Dr. Joseph N. Ivey, associate professor of mathematics, has been appointed head of that department.

Professor Douglas S. Anderson, who was granted a year's leave of absence in 1906–7, and who spent the greater part of his time at the Polytechnic School at Zurich, Switzerland, has returned to take up his work as head of the department of electrical engineering.

Professor William B. Gregory will pursue studies at Cornell University for the session of 1907–8. Mr. James M. Robert will act as his substitute.

Professor B. Palmer Caldwell will take charge of the work in chemistry, Professor John W. Caldwell having retired from this position last June on a Carnegie pension. He will be assisted by Messrs. Scott C. Lyon and H. B. Reese.

Mr. G. Byron Waldrop has been appointed to the teaching fellowship in Greek.

Mr. George J. Theriot and Mr. Sidney Crespo have been appointed instructors of mechanical drawing and mechanic arts, respectively.

Mr. Andre Dreux, graduate of L'Ecole des Chartes, Paris, noted lecturer and critic, has been elected to the vacancy in the department of French in Newcomb College, Miss Marie Augustin having retired from this position last June on a Carnegie pension.

Dr. J. A. C. Mason, former fellow in Columbia University, has been appointed to the chair of history in Newcomb College. Professor Pierce Butler, who formerly held this chair, has been promoted to the chair of English, Mrs. Jane C. Nixon having retired last June on a Carnegie pension.

Miss Margaret E. Cross, head of the department of Latin and psychology in the State Normal School, at Natchitoches, Louisiana, will take charge of the department of education in Newcomb College.

Dr. Edmond Souchon, who taught for twenty-eight years in the medical department of the university, retired last June on a Carnegie pension.

The following promotions and appointments have been made in the medical department since the close of last session:

Dr. Isadore Dyer, associate dean and professor of diseases of the skin; Dr. Paul E. Archinard, professor of diseases of the nervous system; Dr. J. B. Elliott, professor of clinical medicine; Dr. E. D. Fenner, professor of orthopedics and surgical diseases of children; Dr. Henry Bayon, acting professor and demonstrator of anatomy; Dr. Marcus Feingold, professor of ophthalmology; Dr. Charles J. Landfried, professor of otology, laryngology and rhinology; Dr. Herman B. Gessner, associate professor of operative surgery and instructor of clinical surgery; Dr. W. W. Butterworth, associate professor of diseases of children; Dr. S. M. D. Clark, associate professor of gynecology; Dr. George S. Bel, associate professor of clinical medicine; Dr. Marion S. Souchon, assistant demonstrator of anatomy and instructor of clinical surgery; Dr. William M. Perkins, demonstrator of operative surgery and instructor of clinical surgery; Dr. Ralph Hopkins, lecturer and instructor in physiology, hygiene and diseases of the skin; Dr. John Smyth, lecturer and demonstrator in the laboratory of minor surgery and instructor of clinical surgery; Dr. Urban Maes, junior assistant demonstrator of operative surgery and instructor of clinical surgery; Dr. Joseph D. Weis, lecturer and instructor in clinical medicine; Dr. I. I. Lemann, lecturer and instructor in clinical medicine; Dr. J. L. C. Perrilliat, clinical instructor of obstetrics; Dr. Charles C. Bass, instructor of clinical microscopy and clinical medicine; Dr. Edward O. Trahan, assistant demonstrator in the microscopical laboratory; Dr. George J. Tusson, assistant demonstator in the microscopical laboratory; Dr. Sidney K. Simon, instructor of clinical medicine; Dr. Eugene deBellard, assistant demonstrator in the microscopical laboratory; Dr. Carroll W. Allen, instructor of clinical surgery; Dr. J. B. Crawford; junior assistant demonstrator of operative surgery; Drs. C. J. Miller, L. R. DeBuys and P. B. Salatich, chiefs of clinics of obstetrics and gynecology; Drs. P. A. McIlhenny and E. S. Hatch, chiefs of clinics of orthopedics and surgical diseases of children; Dr. Henry Daspit, Jr., chief of clinic for practise of medicine.

The university will erect at once on the campus, opposite Audubon Park, buildings for its medical department at a cost, including laboratories, of $260,000. The first two years' work of the medical department will hereafter be given upon the university campus; the work will be rigidly scientific. The last two years' work will be given in the present downtown building, which is near the Charity Hospital, with which the medical department of the university is affiliated. During the year, three professors will be added to the medical faculty—a professor of anatomy, a professor

of physiology and a professor of pathology. The maximum salary for these positions is fixed at $5,000.

### *ARCHEOLOGICAL WORK IN ARIZONA*

DURING the past season the Committee on American Archeology of the Archeological Institute of America offered properly qualified students the privilege of joining the field expeditions of the Institute in Colorado, Utah and New Mexico. A number of students availed themselves of the opportunity to participate in the practical work of exploration, mapping and excavation of ruins in the San Juan and Rio Grande basins. These expeditions closed on October 1.

Through the courtesy of the Secretary of the Smithsonian Institution the committee is authorized to announce that the government excavations at Casa Grande, in the Gila Valley, Arizona, will be resumed about November 1, under the direction of Dr. J. Walter Fewkes, to continue during the fall and winter, and that students may arrange through the Archeological Institute to participate in the work at this site. As government institutions are not permitted to accept volunteer services, Dr. Fewkes is authorized to pay a limited number of students (not to exceed ten) for their services in connection with the work a nominal salary of ten dollars per month, it being understood that they provide for their own traveling expenses and subsistence. This nominal salary will about cover field subsistence at Casa Grande.

Students desiring to avail themselves of this opportunity should correspond with the undersigned as early as convenient. Applications should be accompanied by the recommendation of the professor under whom the applicant has studied.

EDGAR L. HEWETT,
*Director of American Archeology*

ARCHEOLOGICAL INSTITUTE OF AMERICA,
1333 F STREET, WASHINGTON, D. C.,
October 21, 1907

### *BRITISH MUSEUM MODEL OF EURYPTERUS*

IN the Upper Silurian rocks of the island of Oesel, in the Baltic, are found the fossil remains of an arthropod called *Eurypterus Fischeri*. This animal is of interest as one of an extinct group of arthropods that appear to have been allied to the modern Limulus or king-crab, as well as to the scorpions. These particular fossils have a further interest in that the chitinous substance of the outer coat of the animal has been preserved unaltered in chemical and physical composition. Thus Professor G. Holm, of Stockholm, has been able to dissolve the remains out from the rock by means of acid, and to mount them on glass slides in Canada balsam. On the preparations thus obtained, he based an elaborate description, published in the *Memoirs of the Academy of Science*, St. Petersburg (Ser. 8, Vol. VIII., No. 2, 1898). It can now be said that the structure of this species is known better than that of any other extinct arthropod. Several of Professor Holm's preparations preserved in the geological department of the British Museum are quite marvelous, and it is difficult to believe that one is looking at a fossil at all, still more one dating from the Silurian Epoch.

The perfection of these specimens and the interest of the animal suggested to members of the staff of the British Museum (Natural History) the advisability of preparing a complete model of it, and such a model in colored wax, of about twice the natural size, has now been made under the direction of Dr. W. T. Calman and Dr. F. A. Bather by Mrs. Vernon Blackman, whose beautiful models of plants, of the parasite of malaria, and of the tsetse fly are well known to all visitors to the Natural History Museum in the Cromwell Road.

The model was first placed on exhibition on the occasion of the visit of foreign geologists to the Centenary of the Geological Society of London and evoked their enthusiastic admiration. It measures 23 x 15 cm. The wax of which it is made will stand any extremes of temperature likely to be met with in a museum, and the colors are believed to be quite permanent; they are based upon those of the recent *Limulus*, and Sir Ray Lankester has shown great interest in their selection. The model which, it may be mentioned, has been subjected to the careful scrutiny of Professor

Holm himself, certainly looks quite as natural and life-like as any specimen of a recent arthropod exhibited in the museum.

The geological department hopes to have a limited number of copies of this model, which it is prepared to exchange with other museums. Naturally a model of this nature, which has taken a very long time to make, demands an exchange of considerable value, but for information on this matter inquiries should be addressed to the keeper of the geological department, Natural History Museum, Cromwell Road, London, S. W., England.

## THE RESEARCH LABORATORY OF PHYSICAL CHEMISTRY OF THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

THIS laboratory opened on September 1 for its fifth year. Professor G. N. Lewis has been appointed acting director of the laboratory, in place of Professor A. A. Noyes, who is temporarily acting as president of the institute. Investigations are being carried on in the laboratory by sixteen men of whom ten are devoting their whole time to research work. The new members of the research staff are Professor Carl von Ende (Ph.D., Göttingen), Mr. John Johnston (B.Sc., St. Andrews) and Mr. Roger D. Gale (S.B., Massachusetts Institute of Technology). Mr. R. B. Arnold (S.B., Rose Polytechnic Institute) enters as a candidate for the degree of doctor of philosophy. This degree was conferred last June on three of the research workers in the laboratory, Messrs. Raymond Haskell, R. B. Sosman and M. A. Stewart.

As in the past, a considerable part of the research work bears upon the problems of conductivity in aqueous solutions at high temperatures. The results of the numerous investigations in this field, which have already been completed in this laboratory, have recently appeared in a comprehensive memoir published by the Carnegie Institution. A new form of conductivity bomb, capable of withstanding very high pressures, has recently been constructed. In this bomb the vapor-pressure, density and compressibility of water up to the critical point are being studied, as well as the influence of pressure upon the electrical conductivity of solutions. Closely allied investigations are being made upon electrical transference in mixed salt solutions, the solubility of salts in water at high temperatures, and the dielectric constant of water up to its critical point.

In another field of investigation which is receiving special attention in this laboratory several investigations are under way. These are directed towards the determination of the common electrode potentials, and of the free energy of important chemical reactions. Indirectly but vitally connected with these researches is an investigation of the specific heat of gases at very high temperatures, which is now being undertaken by Professor H. M. Goodwin and Dr. H. T. Kalmus.

The general scheme of qualitative analysis, developed by Professor A. A. Noyes and Dr. W. C. Bray, is being extended to include the detection of the acids. Other investigations begun in previous years on the hydration and the true transference numbers of the ions, on the electromotive force produced in a solution by rotating it at a very high rate of speed, and on the properties of the solutions of metals in liquid ammonia, are being brought to a successful conclusion. Mr. C. A. Kraus, who is carrying on the last-named investigation, has succeeded in finding the missing link between the metallic and the electrolytic conductor, and has thus obtained a new point of attack for the problem of the electron.

During the past year a gift of $500 has been received from the William E. Hale Research Fund and one of $3,000 from a private source in support of the work of the laboratory. In addition, Professor A. A. Noyes has received a grant of $2,000 from the Carnegie Institution for assistance in carrying on the researches above referred to on the conductivity of aqueous solutions.

## THE CHICAGO MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE program for the *entire meeting* will be issued on Monday, December 30. Copies may be obtained at hotel headquarters and at the

office of the permanent secretary, in the Mitchell Tower Arcade, University of Chicago. No "Daily Program" will be issued.

The following events may be announced in advance:

*Saturday, December 28, 1907*

The register for the Chicago meeting will be open at 2 P.M. at the office of the permanent secretary, Auditorium Annex.

The regular meeting of the executive committee, consisting of the general secretary, the secretary of the council, and the secretaries of the different sections, will be held at noon in the rooms of the permanent secretary, at the Auditorium Annex.

*Sunday, December 29, 1907*

The office of the permanent secretary in the Auditorium Annex will be open all day for registration.

*Monday, December 30, 1907*

Meeting of the Council at 9 A.M., at Reynolds Theater, in the Tower group of the University.

First General Session of the Association at 10 A.M. in Leon Mandell Assembly Hall, University of Chicago.

The meeting will be called to order by the retiring president, Dr. W. H. Welch, who will introduce the president of the meeting, Professor E. L. Nichols.

Addresses of welcome will be delivered by Dr. Harry Pratt Judson, president of the University of Chicago, and by Mr. Charles L. Hutchinson, chairman of the Local Committee for the meeting.

Reply by President Nichols.

Announcements by secretaries.

Agreement on the hours of meeting.

Adjournment of the general session, to be followed by the organization of the sections in their respective halls.

Addresses by the vice-presidents at 2:30 P.M. as follows:

Vice-president Kasner, before the Section of Mathematics and Astronomy. Title, "Geometry and Mechanics."

Vice-president Richardson, before the Section of Chemistry. Title, "A Plea for the Broader Education of the Engineer."

Vice-president Conklin, before the Section of Zoology. Title to be announced later.

*Tuesday, December 31, 1907, at 2:30 P.M.*

Vice-president Sabine, before the Section of Physics. Title, "The Origin of the Musical Scale."

Vice-president MacDougal, before the Section of Botany. Title to be announced later.

Vice-president Conant, before the Section of Social and Economic Science. Title, "The Influence of Friction in Economics."

Vice-president Flexner, before the Section of Physiology and Experimental Medicine. Title, "Recent Advances and Present Tendencies in Pathology."

*Wednesday, January 1, 1908, at 2:30 P.M.*

Vice-president Warner, before the Section of Mechanical Science and Engineering. Title to be announced later.

Vice-president Brown, before the Section of Education. Title to be announced later.

OTHER PROGRAM ANNOUNCEMENTS

All the sections of the association and, so far as possible, all the affiliated societies, will meet at the University of Chicago on December 30. Several of the sections of the association will hold sessions in which topics of general interest will be discussed.

At 8 o'clock the retiring president will give his address in Leon Mandell Assembly Hall. At the close of the address a reception will be tendered to the association by President H. P. Judson and the board of trustees of the University of Chicago.

On the following days the sections and societies will hold their regular sessions. It is expected that there will be joint meetings when the same subjects are covered, and that some meetings will be arranged for of general interest to all members of the association. No definite arrangements have been made for the general evening functions after Monday night. Dinners and meetings of special societies and groups, smokers and informal meetings may be arranged for these subsequent evenings.

On Friday afternoon, January 3, there will be a convention of the Sigma Xi, followed by a banquet in the evening.

RAILROAD RATES

THE railroads have generally authorized a reduced rate of two cents per mile each way, on the card-order plan. In order to get the benefit of these reduced rates, a card order, which can only be secured from the office of the permanent secretary, Dr. L. O. Howard, Smithsonian Institution, Washington, D. C., must first be obtained. A card is only good for one ticket, and should a member be accompanied by any members of his family, he will require a card for each person. Members expecting to attend the meeting will therefore advise the permanent secretary immediately of the number of cards desired.

Members residing in the territory of the Western Passenger Association and of the Southwestern Passenger Association are referred to the reduced rates granted by those associations for the holiday season, which will give them practically the same rate as has been granted by other passenger associations, and will obviate the necessity of obtaining a card order.

ANNOUNCEMENTS BY THE LOCAL COMMITTEE

THE University of Chicago is located on the south side of the city, facing the Midway Plaisance. Most of the buildings in which the meetings will be held are located on a plot covering four city blocks, bounded by Ellis Avenue on the west, Lexington Avenue on the east, 57th Street on the north, and 59th Street on the south. The local headquarters are in the Reynolds Club, corner of Lexington Avenue and 57th Street. Enter through Mitchell Tower.

The College of Education, or Emmons-Blaine Hall, is located on 59th Street, between Monroe and Kimbark Avenues.

From the center of the city the university may be reached most easily by taking the Illinois Central suburban express trains. These trains leave the center of the city every twenty minutes from the foot of either Randolph or VanBuren Street. Get off at the 57th Street Station. Take the 'bus, or walk west, six blocks to Lexington Avenue.

The university may be reached from the center of the city and from intermediate points by means of the Cottage Grove Avenue trolley. If the car is marked Grand X, get off at 57th Street and Cottage Grove Avenue and walk east six blocks to Lexington Avenue. If the car is marked Jackson Park, get off at the corner of Lexington and 55th Street, and walk south two blocks.

Passengers arriving by the Lake Shore and Michigan Southern, the Nickel Plate, the Rock Island; Chicago & Eastern Illinois, or the Pennsylvania, may reach the university easily by getting off at the Englewood Station. Take thence the 63d Street trolley east to Cottage Grove Avenue, transfer, and proceed north to 57th Street. Thence walk six blocks east to Lexington Avenue.

Passengers arriving by the Michigan Central, the Illinois Central, the Pere Marquette, or the Big Four, and wishing to go directly to the university, may get off at the 63d Street Station. Transfer to an Illinois Central local or express suburban train, get off at the 57th Street Station, and take 'bus or walk six blocks west to Lexington Avenue.

Passengers arriving over other lines will go to the terminal station of the road in the center of the city and come out to the university as described above.

Passengers over all lines, who wish to locate in hotels in the center of the city, should remain on the train until it reaches the terminal station in the center of the city.

HOTELS

The Auditorium Annex, on Michigan Boulevard and Congress Street will be the general headquarters. The hotels recommended by the local committee are:

Auditorium Annex (Headquarters), Michigan Avenue and Congress Street.
$2.00 and up for single rooms; $1.50 and up per person for double rooms.

The Stratford, Michigan Avenue and Jackson Boulevard.
$1.50 and up, single; $1.25 and up per person, double.
Rooms may be engaged in advance by addressing Percy Tyrrell, manager.

The Victoria, Michigan Avenue and Van Buren Street.
$1.00 and up, single; $1.00 per person, double.

Grand Pacific, Michigan Avenue and Van Buren Street.
$1.50 and up, single; $1.25 and up per person, double.

Great Northern, Jackson and Dearborn Streets.
$1.50 and up, single; $1.25 and up per person, double.

Palmer House, State and Monroe.
$1.50 and up, single; $1.00 and up per person, double.

Wellington, Jackson Boulevard and Wabash Avenue.
$1.00 and up, single; $1.00 and up per person, double.

Kaiserhof, 27 S. Clark Street.
$1.00 and up, single; $1.00 and up per person, double.

McCoy's, Clark and Van Buren Streets.
$1.00 and up, single.

Del Prado, Washington and 59th Streets.
$2.50, American plan, for two in a room, with bath.

Facilities for lunch will be provided on the campus. The Reynolds Club, in the Tower Group, will be thrown open as general headquarters for the members of the association and the affiliated societies. Rest rooms for women are provided in Lexington Hall.

Secretaries of sections and of affiliated societies should notify the local secretary as soon as possible if lanterns are desired for illustrating papers to be read.

AFFILIATED SOCIETIES

All members of affiliated societies who are not members of the association are requested to register at the desk provided for the purpose in the office of the permanent secretary, Mitchell Tower Arcade, University of Chicago, so that an approximate record may be made of the total number of scientific men in attendance of the Convocation Week meetings. The following societies have indicated their intention to meet in Chicago during Convocation Week in affiliation with the American Association for the Advancement of Science:

The American Anthropological Association. President, Dr. Franz Boas, Columbia University, New York, N. Y.; Secretary, Dr. Geo. Grant MacCurdy, Yale University, New Haven, Conn.

Botanical Society of America. Secretary, Professor Duncan S. Johnson, Johns Hopkins University, Baltimore, Md.

The American Chemical Society. President, Marston T. Bogert, New York; Secretary, Chas. L. Parsons, Durham, N. H.

The American Folklore Society. President, Roland B. Dixon, Harvard University; Acting Permanent Secretary, A. M. Tozzer.

The American Mathematical Society. (While this society will hold its annual meeting in New York City during Convocation Week, the Chicago Section will meet with the American Association for the Advancement of Science. The secretary of the section is Professor H. E. Slaught, University of Chicago.)

The American Psychological Association. President, Dr. Henry Rutgers Marshall, New York City; Acting Secretary, Professor R. S. Woodworth, Columbia University.

The American Society of Naturalists. President, Professor J. P. McMurrich, Toronto, Canada; Secretary, Professor Edward L. Thorndike, Teachers College, Columbia University, New York, N. Y.

Association of American Anatomists. Meetings will be held January 1, 2 and 3. President, Franklin P. Mall, Johns Hopkins University, Baltimore, Md.; Secretary, Professor G. Carl Huber, University of Michigan, Ann Arbor, Mich.

Association of American Geographers. President, Professor Angelo Heilprin (deceased); Secretary, Professor Albert P. Brigham, Colgate University, Hamilton, N. Y.

Association of Economic Entomologists. Will meet December 27 and 28. President, Professor H. A. Morgan, Knoxville, Tenn.; Secretary, A. F. Burgess, Department of Agriculture, Washington, D. C.

Entomological Society of America. President, Professor J. H. Comstock, Ithaca, N. Y.; Secretary, J. Chester Bradley, Cornell University, Ithaca, N. Y.

The permanent secretary has received from the local secretary a statement that the American Nature Study Society, the American Federation of Teachers of Mathematics and Physical Science and the Teaching Section of the Lake Placid Conference on Home Economics will meet at the University of Chicago during Convocation Week.

By virtue of a resolution of the council adopted at the New York meeting, the programs of affiliated societies will be published by the association in the general program to be issued on the morning of December 30.

LOCAL EXECUTIVE COMMITTEE FOR THE CHICAGO MEETING

Charles L. Hutchinson,
*Chairman Local Committee.*
John M. Coulter, *Chairman Executive Committee.*

| | |
|---|---|
| John R. Angell, | Charles R. Mann, |
| Thomas C. Chamberlin, | Robert A. Millikan, |
| Joseph P. Iddings, | Charles F. Millspaugh, |
| Frank R. Lillie, | Alexander Smith, |

J. Paul Goode, *Local Secretary.*

## SCIENTIFIC NOTES AND NEWS

THE Royal Society has this year awarded its Davy medal to Dr. E. W. Morley, emeritus professor of chemistry, Western Reserve University, and its Copley medal to Dr. A. A. Michelson, professor of physics, the University of Chicago.

PROFESSOR G. A. MILLER has been appointed secretary of Section A—Mathematics and Astronomy—of the American Association, in place of Professor L. G. Weld, resigned, and all titles and abstracts of papers for the coming Chicago meeting should be sent to Professor Miller, 907 West Nevada Street, Urbana, Illinois.

IN view of the fact that Dr. Elwood Mead has been called to Australia to assume direction under government auspices of irrigation work in that country, the Secretary of Agriculture has divided the work of irrigation and drainage investigations of the Office of Experiment Stations, which Dr. Mead has managed since its establishment in 1898, into two sections. Dr. Samuel Fortier, irrigation engineer in charge of the Pacific district of the irrigation and drainage investigations, and stationed at the University of California, Berkeley, Cal., has been made chief of irrigation investigations. Mr. C. G. Elliott, for several years past engineer in charge of the drainage investigations of the office, has been made chief of drainage investigations.

AT the *Reichsanstalt* Dr. Liebenthal and Dr. Diesselhorst, associates, have been appointed members and professors and Dr. Henning and Dr. Günther Schulze, assistants, have been appointed associates.

AT a recent meeting of the Philadelphia College of Pharmacy the following persons were elected honorary members: Dr. Harvey W. Wiley, chief of the Bureau of Chemistry, U. S. Department of Agriculture, Washington, D. C.; Richard T. Baker, curator and economic botanist of the Technological Museum, Sydney, New South Wales; Henry G. Smith, assistant curator and chemist of the Technological Museum, Sydney, New South Wales; Professor Nagayoshi Nagai, professor of pharmacy in the College of Medicine of the Imperial University of Tokyo, and president of the Pharmaceutical Society of Japan; Dr. H. Thoms, professor of pharmacy and director of the Pharmaceutical Institute of the University of Berlin; Dr. Nathaniel Lord Britton, director of the New York Botanical Garden, New York City.

SIR OLIVER LODGE has accepted the invitation of the council to succeed the late Sir William Perkin in the presidency of the Faraday Society.

DR. CARL BECK, of New York City, is the American member of the committee to establish an institution in Berlin, to bear the name of Dr. Robert Koch.

PROFESSOR WILLIAM CAMPBELL, of Columbia University, has been elected a corresponding member of the Canadian Mining Institute.

DR. HENRY M. HURD, superintendent of the Johns Hopkins Hospital, has returned to Baltimore after spending eight months in Europe.

DR. CHARLES HARRINGTON, secretary of the Massachusetts state board of health, has returned from Europe. He has been absent several weeks attending the International Congress of Hygiene and Demography at Berlin, and studying problems of health in Germany and England.

LIEUTENANT E. H. SHACKLETON, leader of the British Antarctic expedition organized by himself, left London on October 31 for Marseilles, where he will join the P. and O. steamer *India*. He is due at Lyttelton on December 12.

THE regular meeting of the Columbia Chapter of the Society of Sigma Xi was held with the department of physics on October 31. Mr. L. B. Morse presented some of his recent

work under the title "The selective reflection in the infra red characteristic of carbonates and its relation to the atomic weights of the bases."

PROFESSOR JOHN DEWEY, of Columbia University, will lecture before the School of Education of the University of Illinois during the second week of December.

MR. W. E. CHANCELLOR, superintendent of the schools of Washington, D. C., will give a course of twenty lectures at the Johns Hopkins University, on the "History of Theory of Education."

DR. EDWARD GARDINER, of Boston, Mass., known for his work on *Turbellaria* and for his active interest in the Marine Biological Laboratory at Woods Hole, of the corporation of which he was secretary, died suddenly from pneumonia on November 4.

WE regret also to record the death, at the age of seventy-two years, of Mr. Howard Saunders, the eminent British ornithologist.

THE Field Museum of Natural History, Chicago, profited by a decision rendered by Judge Cutting of the Chicago Probate Court to the extent of $430,000. The money was paid by the late Marshall Field to the trustees of the museum prior to the date of his will, which contained a bequest of $8,000,000 to the institution. A suit was brought by the trustees against the executors of the will to determine whether the bequest was intended to be exclusive of the amount previously donated. Judge Cutting decided the suit in favor of the museum on the testimony of President H. N. Higinbotham of the board of trustees and of Frederick L. V. Skiff, curator of the museum, who related conversations with the decedent which were held to indicate his intention.

To serve as a botanic garden for the University of Chicago, about four acres of ground have been set apart in the block adjoining Washington Park and the Midway Plaisance. It is easily accessible from the Hull Botanical Laboratory, and is to be strictly a laboratory garden, which will add greatly to the facilities for experimental work. The area, it is hoped, will be largely increased with the further development of plans.

A CERTIFICATE of incorporation has been filed with the secretary of state for the Russell Sage Institute of Pathology of New York City. The directors are Drs. Edward G. Janeway, Theodore C. Janeway, D. Bryson Delavan, Simon Flexner and Graham Lusk. This institute will act as pathologist for the City Hospital and City Home on Blackwell's Island. Heretofore these institutions have had no laboratories for pathologic work.

THE president of Santo Domingo, under date of September 17, 1907, published a decree relating to objects of archeological interest discovered upon the island which will be of interest to collectors. After explaining that the archeological remains in the island should be preserved, that a museum should be established for the purpose, and that many objects have been taken from the island, the decree goes on to state that such objects are the exclusive property of the nation and therefore shall not be taken from the country or appropriated by private persons. Private collections already made will not be disturbed, but they must not be removed from the republic. Any person finding one of these objects shall deliver it to the superior authority of the province or district in which it is found, who shall have the object deposited in a suitable place, inform the government of the discovery and have the fact published in the newspapers. A register of these discoveries shall be kept by the governors of the various provinces. Any person violating the provisions of this decree shall be punished according to law.

THE American Scenic and Historic Preservation Society held a meeting in the new building of the New York Historical Society on November 14, to commemorate the anniversary of the birth of Robert Fulton on November 14, 1765, and the centenary of the successful inauguration by him of steam navigation on the Hudson River in 1807. From 8 to 8:30 o'clock there was a reception at which descendants of Robert Fulton were the guests of honor. Beginning at 8:30 addresses were announced by Gen. Stewart L. Woodford, president of the Hudson-Fulton Celebration Commission; Rear Admiral Joseph B.

Coghlan, representing the United States Navy; Captain George A. White, representing the Hudson River steamboat interests; Mr. Samuel Verplanck Hoffman, president of the New York Historical Society; and Mrs. Robert Abbe, president of the City History Club; concluding with an exhibition of stereopticon views illustrating Fulton's work and the progress of steam navigation during the century.

THE Rhode Island College of Agriculture and Mechanic Arts, at Kingston, R. I., announces the following course of popular scientific lectures, which are open to the public:

October 25—"Recent Studies in Heredity and their bearing upon the Problems of Breeding," by Professor W. E. Castle, Department of Zoology, Harvard University.

November 2—"Central America: Its People and its Monuments," by Dr. Alfred M. Tozzer, instructor in anthropology, Harvard University.

November 8—"Sea Farming," by Professor Frederic P. Gorham, Department of Biology, Brown University.

November 16—"The Theories of Bird Migration," by Professor H. E. Walter, Department of Comparative Anatomy, Brown University.

November 23—"The Evolution of the Earth," by Charles W. Brown, head of Department of Geology, Brown University.

December 6—"Some Principles of Organic Evolution," by Professor A. D. Mead, Department of Comparative Anatomy, Brown University.

January 11—"The Question of the Origin and Artificial Production of Life," by Dr. Leon J. Cole, instructor in zoology, Yale University

*The British Medical Journal* states that the recent election of Dr. Pièrart brings up the total number of representatives of the medical profession in the Belgian parliament to ten. Of these four belong to the liberal left; four, including the new member, to the right; and two to the socialist left.

ARRANGEMENTS have been completed for the running of a horticultural and soil improvement special train over the Baltimore, Ohio and Southwestern Railroad, in Indiana, about November 19–22, 1907. This movement is the result of cooperation of the railways, Purdue Experiment Station and the Indiana State Horticultural Society. The train is to be equipped and operated by the railway, while the lecturers will be furnished by the Experiment Station and the State Horticultural Society. Stops of one hour will be made at all the important stations, and talks given on the various lines of work. That part of southern Indiana through which the train will pass is especially adapted to fruit growing, and an effort will be made to point out ways by which the average farmer can profitably engage in the business. Along soil improvement lines information will be given on the value and use of commercial fertilizers. In this connection the results of experiments conducted in southern Indiana will be presented. The horticultural work will be in charge of C. G. Woodbury, of the Horticultural Department, while the soil work will be under the direction of Professor Arthur Goss.

WE learn from the London *Times* that Sir W. H. White presided on October 17 at the sixth annual meeting of the Northern Scientific Club in Newcastle. After the formal business the president gave an address upon the application of the gyroscope for steadying ships. He showed a working model of Dr. Schlick's apparatus which, he said, when applied to cross-channel boats and coasting passenger steamers, would so prevent the rolling of these vessels as to allow persons troubled with sea sickness to travel on the sea in comfort. The gyroscope had reached beyond the toy stage, which was proved by the fact that the firm who had built the Mauretania were to develop Dr. Schlick's apparatus.

THE Forest Club of the University of Nebraska announces addresses for the first half of the present year as follows:

October 8—"Forest Conditions in Michigan," Professor F. J. Phillips.

October 22—"Forest Insects" (illustrated), Professor L. Bruner.

November 5—"Growth of Mistletoe," Mr. R. J. Pool.

November 19—"The Forest Ranger," Mr. J. Higgins.

December 3—"Forest Trees of the World," Dr. Chas. E. Bessey.

December 17—"Utilization of Colorado National Forests," Theodore R. Cooper. "Lumbering in Colorado," Claude R. Tillotson.

January 7—"Fungus Diseases of Trees," Dr. F. D. Heald.

The department of archeology, Phillips Academy, announces the following lectures to be delivered in the lecture hall of the Archeology Building at 7:30 o'clock:

October 31—"Evolution and the Ascent of Man" (illustrated), Warren K. Moorehead.

November 21—"Prehistoric Man in Europe" (illustrated), Charles Peabody.

December 5—"Prehistoric Man in America" (illustrated), Warren K. Moorehead.

January 9—"The Plains Indians" (illustrated), Warren K. Moorehead.

January 23—"Mound Building Tribes" (illustrated), Warren K. Moorehead.

February 6—"Prehistoric and Primitive Art" (illustrated), Charles Peabody.

February 20—"The Cliff Dwellers" (illustrated), Warren K. Moorehead.

March 5—"Central and South American Archeology" (illustrated), Charles Peabody.

March 19—"The Pueblo Culture" (illustrated), Warren K. Moorehead.

April 2—"The American Indian in History and His Destiny," Warren K. Moorehead.

The Teachers' School of Science, established by the Lowell Institute of Boston, offers this winter, as a new departure, a course of fifteen lectures to teachers, on the fundamental principles of physical chemistry, discussed with special reference to their application in the teaching of elementary science. The lectures will be given by Professor G. N. Lewis, of Massachusetts Institute of Technology, on Saturday forenoons, beginning November 16. This course is offered at the request of the New England Association of Chemistry Teachers and will be open free of charge to all science teachers.

*Nature* states that the Philosophical Institute of Canterbury, New Zealand, is making arrangements for an expedition to some southern islands included in the colony's boundaries. The expedition will be under the leadership of the Hon. R. McNab, minister of lands and minister for agriculture, who is interested in the history of the islands, and has written an interesting work dealing with the old sealing and whaling days in the islands and the southern part of the mainland. The expedition will be under the auspices of the government, and will be taken to the islands in one of the government's steamers. It will leave New Zealand about the end of November or the beginning of December, and will visit the Auckland Islands and Campbell Islands. About twenty New Zealand men of science will take part in the undertaking. They will be divided into two parties, one going to each group. Work will be done in regard to terrestrial magnetism, zoology, geology and botany, and reports will be prepared dealing with the results of the investigations.

The report of the Departmental Committee appointed to inquire and report as to the nature and extent of the benefit accruing to British arts and industries from the participation of Great Britain in great international exhibitions, has been issued as a parliamentary paper. According to an abstract in *Nature*, the committee found that the evidence it received went to show that international exhibitions are of little use to the textile and other great staple industries of the country. The committee is, however, in favor of the continued participation of this country in all really important exhibitions, owing to the indirect advantages resulting. One aspect of exhibitions to which considerable importance should be attached is the effect which they have in encouraging national emulation and in stimulating individual exhibitors to improve their productions. Examples of the effects which particular exhibitions have had on the development of different industries will be found in the evidence of Sir William Preece, K.C.B., Mr. Bennett Brough, and other witnesses. Sir William Preece attributes to the Paris Exhibition of 1881 many of the most important developments of the electrical industry. The exhibition at Paris of certain high-speed tool steels by an American firm is said by Mr. Bennett Brough to have contributed in a large degree to the development of what has become a British industry of great magnitude; and an exhibit by the Courrières Colliery Company, at the mines of which the death-rate from falls of roof was abnormally low, has since led to considerable improvement

in the methods of timbering employed and a consequent decrease in the death rate. The report concludes with important recommendations for securing in future continuity of organization from exhibition to exhibition, and more effective representation at any exhibition in which the government may take part.

We learn from *The Harvard University Gazette* that the session at the Bermuda Station this summer extended from June 21 to August 7. The new station is located on Agar's Island, near the entrance to Hamilton Harbor. This island contains about three acres of land, and has numerous substantial buildings. It was formerly used by the British government for the storage of munitions of war, and for the accommodation of the necessary garrison. It has been secured by the Bermuda Natural History Society for the purposes of a public aquarium and a station for biological research. The powder magazine is being converted into an aquarium of the grotto type, and other buildings have been adapted to laboratory, lodging, and dining requirements. The following Harvard men were enrolled at the station this year: Professor E. L. Mark, director; Dr. H. W. Rand (Ph.D. 1900), in charge from June 21 till July 5; Dr. A. M. Banta (Ph.D. 1907), professor of biology at Marietta College, Marietta, Ohio; Professor Webster Chester (university scholar), Colby College, Waterville, Me.; Dr. C. O. Esterly (Ph.D. 1907), professor of biology in Occidental College, Los Angeles, Cal.; Professor H. M. Kelly (A.M. 1893), Cornell College, Ia.; Mr. J. A. Long (G. B. Emerson Scholar); and Mr. J. W. Mavor (Thayer Scholar).

## UNIVERSITY AND EDUCATIONAL NEWS

By the will of Mrs. Sarah E. Potter, of Boston, for some years a member of the committee to visit the Gray Herbarium, Harvard University received in June a bequest of $50,000 to be used in connection with the herbarium, and to be called the Sarah E. Potter endowment fund. As one of a number of residuary legatees, the university has now received an addition to this endowment of $130,000.

Harvard University has also received from Miss Maria Whitney, of Cambridge, the sum of $5,000, the income thereof to be applied to the care and increase of the Whitney Library of the Museum of Comparative Zoology.

Clark Hall, of the Massachusetts Agricultural College, the new building named after Col. William S. Clark, an enthusiastic botanist and one of the first presidents of the institution, was dedicated on October 2. Professor D. P. Penhallow, D.Sc., F.R.S.C., of McGill University, gave an address on "William Smith Clark: his place as a scientist and his relation to the development of scientific agriculture"; and Professor John M. Tyler, Ph.D., of Amherst College, read a paper entitled "Reminiscences of Col. W. S. Clark."

According to data published by the Ministry of Education, the attendance of regular students at the summer semester was as follows: Total number of students, 21,504; of whom 9,535 were in law, 7,525 in philosophy, 3,100 in medicine and 1,344 in theology. Vienna had 7,360, the Prague Bohemian University 3,417, the Prague German University 1,407, Lemberg University 3,097, Krakov 2,622, Gratz 1,700 and Innsbruck 1,026.

Dr. Harry L. Whittle has been appointed instructor in physiological chemistry in the University of Maryland.

Dr. H. M. Tory, professor of mathematics at McGill University, has resigned to take the presidency of the newly-established provincial university at Alberta.

Sir Arthur Rücker has intimated his intention to resign the principalship of the University of London in September next.

Mr. Howard Marsh, formerly surgeon to St. Bartholomew's Hospital, and since 1903 professor of surgery in the University of Cambridge, has been elected master of Downing College in succession to Dr. Alex Hill, who had held the post since 1888.

Mr. Leonard T. Hobhouse has been appointed to the professorship of sociology in London University, recently endowed by Mr. Martin White.